IEI Centenary Publication

The Legacy

A Compilation Volume of Presidents' Speeches presented during Annual General Meetings of IEI

35th Indian Engineering Congress

December 18-20, 2020

The Institution of Engineers (India)

8 Gokhale Road, Kolkata

Presidents of IEI .....

Sir Thomas R J Ward 1920-21 1
Founder President

Sir Rajendra Nath Mookerjee 1921-22 2
Delivered the First Presidential Address during 1st Annual General Meeting of The Institution of Engineers (India) at Asiatic Society of Bengal, February 23, 1921

Lt Col G H Wills 1922-23 8
Delivered the Second Presidential Address during 2nd Annual General Meeting of The Institution of Engineers (India) at Hall of Missing to Seamen, Bombay, January 30, 1922

Mr A C Coubrough 1923-24 12
Delivered the Third Presidential Address during 3rd Annual General Meeting of The Institution of Engineers (India) at Canning College Hall, Lucknow, January 29, 1923

Sir Clement D M Hindley 1924-25 18
Delivered the Fourth Presidential Address during 4th Annual General Meeting of The Institution of Engineers (India) at Indian Museum Chawringhee, Calcutta, February 4, 1924

Mr H Burkinshaw 1925-26 22
Delivered the Fifth Presidential Address during 5th Annual General Meeting of The Institution of Engineers (India) at YMCA Hall Kingsway, Delhi, February 23, 1925

Deewan Bahadur A V Ramalinga Aiyar 1926 26
Delivered the Sixth Presidential Address during 6th Annual General Meeting of The Institution of Engineers (India) at Council Chamber Ripon Buildings, Madras, February 01, 1926

Mr W H Neilson 1926-27 30
Delivered the Seventh Presidential Address during 7th Annual General Meeting of The Institution of Engineers (India) at Seamen's Institute, Ballard Estate, Bombay, December 01, 1926

Sir James S Piekeathly 1927-28 52
Delivered the Eighth Presidential Address during 8th Annual General Meeting of The Institution of Engineers (India) at Registered Office of the Institution, 8 Esplanade Row East Calcutta, December 12, 1927

Lt Col R D T Alexander 1928-29 57
Delivered the Ninth Presidential Address during 9th Annual General Meeting of The Institution of Engineers (India) at MetCalfe Hall, Delhi, November 07, 1928

Lieut Genl Sir Edwin H De Vere Atkinson 1929-30 60
Delivered the Tenth Presidential Address during 10th Annual General Meeting of The Institution of Engineers (India) at Royal Institute of SC, Bombay, January 27, 1930

Mr C Addams Williams 1930-31 65
Delivered the Eleventh Presidential Address during 11th Annual General Meeting of The Institution of Engineers (India) at the Institution, 8 Esplanade Row East, Calcutta, December 19, 1930

Raja Jwala Prasad 1931-32 69
Delivered the Twelfth Presidential Address during 12th Annual General Meeting of The Institution of Engineers (India) at Kaiserbagh Bradari, Lucknow, January 30, 1932

Dr A Jardine 1932-33 73
Delivered the Thirteenth Presidential Address during 13th Annual General Meeting of The Institution of Engineers (India) at Sir Hugh Daly Memorial Hall, Bangalore, January 16, 1933

Sir Guthrie Russell 1933-34 78
Delivered the Fourteenth Presidential Address during 14th Annual General Meeting of The Institution of Engineers (India) at Town Hall New, Delhi, January 29, 1934

Rai Bahadur B P Varma 1934-35 84
Delivered the Fifteenth Presidential Address during 15th Annual General Meeting of The Institution of Engineers (India) at IEI HQ, 6 Gokhale Road, Calcutta, January 09, 1935

Col F C Temple 1935-36 89
Delivered the Sixteenth Presidential Address during 16th Annual General Meeting of The Institution of Engineers (India) at Senate Hall Madras, January 07, 1936

Rai Bahadur Chuttan Lal 1936-37 93
Delivered the Seventeenth Presidential Address during 17th Annual General Meeting of The Institution of Engineers (India) at Taj Mahal Hotel Bombay, January 11, 1937

Shri Fakirijee E Bharucha 1937-38 97
Delivered the Eighteenth Presidential Address during 18th Annual General Meeting of The Institution of Engineers (India) at Town Hall Hyderabad (Decean), December 30, 1937

Mr E J B Greenwood 1938-39 106
Delivered the Nineteenth Presidential Address during 19th Annual General Meeting of The Institution of Engineers (India) at Arts College Hall of the Banaras Hindu University, January 13, 1939

Khan Bahadur M Abdul Aziz 1939-40 111
Delivered the Twentieth Presidential Address during 20th Annual General Meeting of The Institution of Engineers (India) at Hailey Hall, Lahore, January 12, 1940

Mr N V Modak 1941 118
Delivered the Twenty-first Presidential Address during 21st Annual General Meeting of The Institution of Engineers (India) at Central Hall College of Engineering, Poona, January 31, 1941

Mr N V Modak 1942 130
Delivered the Twenty-second Presidential Address during 22nd Annual General Meeting of The Institution of Engineers (India) at Association Building, Bangalore, January 16, 1942

Sir Lakshmi Pati Misra 1942-43 139
Delivered the Twenty-third Presidential Address during 23rd Annual General Meeting of The Institution of Engineers (India) at Municipal Hall Lucknow, February 24, 1943

Mr T R Sneyd-Kynnersley 1944 146
Delivered the Twenty-fourth Presidential Address during 24th Annual General Meeting of The Institution of Engineers (India) at University Hall, Lahore, February 18, 1944

Shri H P Bhaumik 1944-45 157
Delivered the Twenty-fifth Presidential Address during 25th Annual General Meeting of The Institution of Engineers (India) at Art College Osmania University, Hyderabad, January 02, 1945

Nawab Zain Yar Jung Bahadur 1945-46 169
Delivered the Twenty-sixth Presidential Address during 26th Annual General Meeting (Silver Jubilee Session) of The Institution of Engineers (India) at Lecture Hall, 8 Gokhela Road, Calcutta, December 27, 1945

Mr E A Nadirshah 1946-47 177
Delivered the Twenty-seventh Presidential Address during 27th Annual General Meeting of The Institution of Engineers (India) at Council Chamber, Trivandrum, February 13, 1947

Rai N K Mitra Bahadur 1947-48 193
Delivered the Twenty-eighth Presidential Address during 28th Annual General Meeting of The Institution of Engineers (India) at Grill Room Connemara Hotel, Madras, February 21, 1948

Rai Bahadur Dr A N Khosla 1948-49 208
Delivered the Twenty-ninth Presidential Address during 29th Annual General Meeting of The Institution of Engineers (India) at Victoria Jubilee Technical Institute Hall, Nagpur, January 23, 1949

Rai Bahadur Dr A N Khosla 1949-50 214
Delivered the Thirtieth Presidential Address during 30th Annual General Meeting of The Institution of Engineers (India) at Lady Stephenson Hall, Patna, January 28, 1950

Shri K C Bakhle 1951-52 222
Delivered the Thirty-first Presidential Address during 31st Annual General Meeting of The Institution of Engineers (India) at Crawford Hall, Mysore, February 3-6, 1951

Shri M S Thirumale Iyengar 1952-53 228
Delivered the Thirty-second Presidential Address during 32nd Annual General Meeting of The Institution of Engineers (India) at Parliament House, New Delhi, January 19-20, 1952

Shri Dildar Husain 1952-53 240
Delivered the Thirty-third Presidential Address during 33rd Annual General Meeting of The Institution of Engineers (India) at Council Hall, Bombay, January 24-30, 1953

Major General Harold Williams 1953-54 256
Delivered the Thirty-fourth Presidential Address during 34th Annual General Meeting of The Institution of Engineers (India) at Institution Premises, Calcutta, February 13-17, 1954

Shri S B Joshi 1954-55 265
Delivered the Thirty-fifth Presidential Address during 35th Annual General Meeting of The Institution of Engineers (India) at Institution Building, Hyderabad, February 19-24, 1955

Prof M S Thacker 1955-56 283
Delivered the Thirty-sixth Presidential Address during 36th Annual General Meeting of The Institution of Engineers (India) at Chandigarh, February 14-18, 1956

Rai Bahadur Kanwar Sain 1956-57 290
Delivered the Thirty-seventh Presidential Address during 37th Annual General Meeting of The Institution of Engineers (India) at Trivandrum, January 30 to February 2, 1957

Shri D P R Cassad 1957-58 304
Delivered the Thirty-eighth Presidential Address during 38th Annual General Meeting of The Institution of Engineers (India) at Lucknow, February 15-18, 1958

Dr K L Rao 1958-59 315
Delivered the Thirty-ninth Presidential Address during 39th Annual General Meeting of The Institution of Engineers (India) at Madras, January 30 to February 2, 1959

Dr K L Rao 1959-60 331
Delivered the Forty Presidential Address during 40th Annual General Meeting of The Institution of Engineers (India) at New Delhi, February 4-7, 1960

Maj Gen Harkirat Singh 1960-61 339
Delivered the Forty-first Presidential Address during 41st Annual General Meeting (41 Annual Convention) of The Institution of Engineers (India) at Bombay, February 3-7, 1961

Maj Gen Harkirat Singh 1961-62 348
Delivered the Forty-second Presidential Address during 42nd Annual General Meeting (42 Annual Convention) of The Institution of Engineers (India) at Calcutta, February 3, 1962

Dr T Sen 1962-63 355
Delivered the Forty-third Presidential Address during 43rd Annual General Meeting (43 Annual Convention) of The Institution of Engineers (India) at Bangalore, May 18-25, 1963

Dr T Sen 1963-64 360
Delivered the Forty-fourth Presidential Address during 44th Annual General Meeting (44 Annual Convention) of The Institution of Engineers (India) at Hyderabad, February 8-13, 1964

Prof N S Govinda Rao 1965-66 365
Delivered the Forty-fifth Presidential Address during 45th Annual General Meeting (45 Annual Convention) of The Institution of Engineers (India) at Lucknow, February 20-23, 1965

Shri B P Kapadia 1966-67 374
Delivered the Forty-sixth Presidential Address during 46th Annual General Meeting (46 Annual Convention) of The Institution of Engineers (India) at Patna, January 29 to February 5, 1966

Maj Gen S P Vohra 1967-68 386
Delivered the Forty-seventh Presidential Address during 47th Annual General Meeting (47 Annual Convention) of The Institution of Engineers (India) at Bombay, February 24-28, 1967

Shri K F Antia 1968-69 399
Delivered the Forty-eighth Presidential Address during 48th Annual General Meeting (48 Annual Convention) of The Institution of Engineers (India) at Ahmedabad, February 9-14, 1968

Shri T R Gupta 1969-70 409
Delivered the Forty-ninth Presidential Address during 49th Annual General Meeting (49 Annual Convention) of The Institution of Engineers (India) at Jaipur, February 15-22, 1969

Lt Gen R A Loomba 1970-71 420
Delivered the Fifty Presidential Address during 50th Annual General Meeting (50 Annual Convention Golden Jubilee Convention) of The Institution of Engineers (India) at Calcutta, February 4-8, 1970

Shri J G Bodhe 1971-72 429
Delivered the Fifty-one Presidential Address during 51st Annual General Meeting (51 Annual Convention) of The Institution of Engineers (India) at Chandigarh, February 11-17, 1971

Shri J G Bodhe 1972-73 436
Delivered the Fifty-second Presidential Address during 52nd Annual General Meeting (52 Annual Convention) of The Institution of Engineers (India) at Bombay, February 11-15, 1972

Shri M Ganapati 1973-74 456

Delivered the Fifty-third Presidential Address during 53rd Annual General Meeting (53 Annual Convention) of The Institution of Engineers (India) at Madras, February 17-20, 1973

Dr Jai Krishna 1974-75 474

Delivered the Fifty-fourth Presidential Address during 54th Annual General Meeting (54 Annual Convention) of The Institution of Engineers (India) at Poona, February 14-18, 1974

Dr V M Dokras 1975-76 482

Delivered the Fifty-fifth Presidential Address during 55th Annual General Meeting (55 Annual Convention) of The Institution of Engineers (India) at Lucknow, February 14-19, 1975

Prof Dr A Bhattacharyya 1976-77 491

Delivered the Fifty-sixth Presidential Address during 56th Annual General Meeting (56 Annual Convention) of The Institution of Engineers (India) at Ahmedabad, January 16-21, 1976

Prof Dr A Bhattacharyya 1977-78 502

Delivered the Fifty-seventh Presidential Address during 57th Annual General Meeting (57 Annual Convention) of The Institution of Engineers (India) at Chandigarh, April 9-11, 1977

Lt Gen J S Bawa 1978-79 523

Delivered the Fifty-eighth Presidential Address during 58th Annual General Meeting (58 Annual Convention) of The Institution of Engineers (India) at Gauhati, January 13-15, 1978

Lt Gen J S Bawa 1979-80 529

Delivered the Fifty-ninth Presidential Address during 59th Annual General Meeting (59 Annual Convention) of The Institution of Engineers (India) at Bangalore, January 6-10, 1979

Shri S G Ramachandra 1980-81 538

Delivered the Sixtieth Presidential Address during 60th Annual General Meeting (60 Annual Convention Diamond Jubilee Convention) of The Institution of Engineers (India) at Calcutta, January 14-20, 1980

Shri S G Ramachandra 1981-82 549

Delivered the Sixty-one Presidential Address during 61st Annual General Meeting (61 Annual Convention) of The Institution of Engineers (India) at Hyderabad, February 6-9, 1981

Dr Shankar Lal 1982-83 559

Delivered the Sixty-second Presidential Address during 62nd Annual General Meeting (62 Annual Convention) of The Institution of Engineers (India) at Bombay January 29 to February 2, 1982

Shri M D Patel 1983-84 567

Delivered the Sixty-third Presidential Address during 63rd Annual General Meeting (63 Annual Convention) of The Institution of Engineers (India) at Madras, January 7-10, 1983

Shri S K Mukherjee 1984-85 582

Delivered the Sixty-fourth Presidential Address during 64th Annual General Meeting (64 Annual Convention) of The Institution of Engineers (India) at Patna, February 2-6, 1984

Shri C R Alimchandani 1985-86 595

Delivered the Sixty-fifth Presidential Address during 65th Annual General Meeting (65 Annual Convention) of The Institution of Engineers (India) at Jaipur, February 15-18, 1985

Prof B R Narayana Iyengar 1986-87 601

Delivered the Sixty-sixth Presidential Address during 66th Annual General Meeting (66 Annual Convention) of The Institution of Engineers (India) at Ahmedabad, January 10-13, 1986

Dr Satish Chandra 1987-88 610

Delivered the Sixty-seventh Presidential Address during 67th Annual General Meeting (First Indian Engineering Congress) of The Institution of Engineers (India) at Kolkata, January 9-13, 1987

Shri K M Chakravorti 1988-89 623

Delivered the Sixty-eighth Presidential Address during 68th Annual General Meeting (Second Indian Engineering Congress) of The Institution of Engineers (India) Hyderabad, January 15-19, 1988

Shri P R Bapat 1989-90 627

Delivered the Sixty-ninth Presidential Address during 69th Annual General Meeting (Third Indian Engineering Congress) of The Institution of Engineers (India) Madras, January 19-24, 1989

Dr H C Visvesvaraya 1990-91 650

Delivered the Seventieth Presidential Address during 70th Annual General Meeting (Fourth Indian Engineering Congress) of The Institution of Engineers (India) Bhubaneswar, December 30 1989 to January 02, 1990

Shri P J Mehta 1991-92 665
Delivered the Seventy-one Presidential Address during 71st Annual General Meeting (Fifth Indian Engineering Congress) of The Institution of Engineers (India) Kanpur, December 14-18, 1990

Shri G P Lal 1992-93 676
Delivered the Seventy-second Presidential Address during 72nd Annual General Meeting (Sixth Indian Engineering Congress) of The Institution of Engineers (India) Pune, December 20-24, 1991

Shri G P Lal 1993-94 685
Delivered the Seventy-third Presidential Address during 73rd Annual General Meeting (Seventh Indian Engineering Congress) of The Institution of Engineers (India) Bangalore, December 26-30, 1992

Shri P M Chacko 1994-95 696
Delivered the Seventy-fourth Presidential Address during 74th Annual General Meeting (Eighth Indian Engineering Congress) of The Institution of Engineers (India) New Delhi, January 01-04, 1994

Shri P M Chacko 1995-96 704
Delivered the Seventy-fifth Presidential Address during 75th Annual General Meeting (Platinum Jubilee Convention) (Ninth Indian Engineering Congress) of The Institution of Engineers (India) Kolkata, December 15-20, 1994

Shri N C Vaish 1996-97 710
Delivered the Seventy-sixth Presidential Address during 76th Annual General Meeting (Tenth Indian Engineering Congress) of The Institution of Engineers (India) Jaipur, December 20-23, 1995

Shri K V Chaubal 1997-98 718
Delivered the Seventy-seventh Presidential Address during 77th Annual General Meeting (Eleventh Indian Engineering Congress) of The Institution of Engineers (India) Bangalore, December 20-24, 1996

Prof A K Ghose 1998-99 738
Delivered the Seventy-eighth Presidential Address during 78th Annual General Meeting (Twelfth Indian Engineering Congress) of The Institution of Engineers (India) Nagpur, January 09-13, 1998

Prof (Dr) M P Chowdiah 1999-2000 745
Delivered the Seventy-ninth Presidential Address during 79th Annual General Meeting (Thirteenth Indian Engineering Congress) of The Institution of Engineers (India) Chandigarh, April 25-26, 1999

Shri Jagman Singh 2000-01 764
Delivered the Eightieth Presidential Address during 80th Annual General Meeting (Fourteenth Indian Engineering Congress) of The Institution of Engineers (India) New Delhi, January 29-31, 2000

Shri H P Jamdar 2001-02 781
Delivered the Eighty-one Presidential Address during 81st Annual General Meeting (Fifteenth Indian Engineering Congress) of The Institution of Engineers (India) Hyderabad, December 18-22, 2000

Prof (Dr) Samiran Choudhuri 2002-03 785
Delivered the Eighty-second Presidential Address during 82nd Annual General Meeting (Sixteenth Indian Engineering Congress) of The Institution of Engineers (India) Kharagpur, December 01-04, 2001

Shri G L Rao 2003-04 791
Delivered the Eighty-third Presidential Address during 83rd Annual General Meeting (Seventeenth Indian Engineering Congress) of The Institution of Engineers (India) Patna, December 19-22, 2002

Shri O P Goal 2003-04 797
Delivered the Eighty-fourth Presidential Address during 84th Annual General Meeting (Eighteenth Indian Engineering Congress) of The Institution of Engineers (India) Lucknow, December 18- 21, 2003

Shri B J Vasoya 2004-05 806
Delivered the Eighty-fifth Presidential Address during 85th Annual General Meeting (Nineteenth Indian Engineering Congress) of The Institution of Engineers (India) Mumbai, December 16-19, 2004

Prof (Dr) S C Naik 2005-06 814
Delivered the Eighty-sixth Presidential Address during 86th Annual General Meeting (Twentieth Indian Engineering Congress) of The Institution of Engineers (India) Kolkata, December 15-18, 2005

Shri D K Gowda 2006-07 825
Delivered the Eighty-seventh Presidential Address during 87th Annual General Meeting (Twenty-one Indian Engineering Congress) of The Institution of Engineers (India) Guwahati, December 21-24, 2006

Shri R P Gupta 2007-08 829
Delivered the Eighty-eighth Presidential Address during 88th Annual General Meeting (Twenty-second Indian Engineering Congress) of The Institution of Engineers (India) Udaipur, December 13-16, 2007

Vice Admiral K O Thakare 2008-09 835
Delivered the Eighty-ninth Presidential Address during 89th Annual General Meeting (Twenty-third Indian Engineering Congress) of The Institution of Engineers (India) Warrangal, December 11-14, 2008

Shri Madan Lal 2009-10 842
Delivered the Nineteenth Presidential Address during 90th Annual General Meeting (Twenty-fourth Indian Engineering Congress) of The Institution of Engineers (India) Mangalore, December 10-13, 2009

Mr G Prabhakar 2010-11 855
Delivered the Ninety-one Presidential Address during 91st Annual General Meeting (Twenty-fifth Indian Engineering Congress) of The Institution of Engineers (India) Kochi, December 16-19, 2010

Shri S L Garg 2011-12 863
Delivered the Ninety-second Presidential Address during 92nd Annual General Meeting (Twenty-sixth Indian Engineering Congress) of The Institution of Engineers (India) Bangalore, December 15-18, 2011

Mr S S Rathore 2012-13 868
Delivered the Ninety-third Presidential Address during 93rd Annual General Meeting (Twenty-seventh Indian Engineering Congress) of The Institution of Engineers (India) New Delhi, December 13-16, 2012

Mr Ashok Kumar Basa 2013-14 875
Delivered the Ninety-fourth Presidential Address during 94th Annual General Meeting (Twenty-eighth Indian Engineering Congress) of The Institution of Engineers (India) Chennai, December 20-22, 2013

Dr L V Muralikrishna Reddy 2014-15 881
Delivered the Ninety-fifth Presidential Address during 95th Annual General Meeting (Twenty-ninth Indian Engineering Congress) of The Institution of Engineers (India) Hyderabad, December 18-21, 2014

Mr H C S Berry 2015-16 891
Delivered the Ninety-sixth Presidential Address during 96th Annual General Meeting (Thirtieth Indian Engineering Congress) of The Institution of Engineers (India) Guwahati, December 17-20, 2015

Mr Navinchandra B Vasoya 2016-17 897
Delivered the Ninety-seventh Presidential Address during 97th Annual General Meeting (Thirty-first Indian Engineering Congress) of The Institution of Engineers (India) Kolkata, December 16-18, 2016

Mr Sisir Kr Banerjee 2017-18 902
Delivered the Ninety-eighth Presidential Address during 98th Annual General Meeting (Thirty-second Indian Engineering Congress) of The Institution of Engineers (India) Chennai, December 21-23, 2017

Mr T M Gunaraja 2018-19 908
Delivered the Ninety-ninth Presidential Address during 99th Annual General Meeting (Thirty-third Indian Engineering Congress) of The Institution of Engineers (India) Udaipur, December 21-23, 2018

Er Narendra Singh 2019-20 913
Delivered the Hundredth Presidential Address during 100th Annual General Meeting (Thirty-fourth Indian Engineering Congress) of The Institution of Engineers (India) Hyderabad, December 27-29, 2019

Sir Thomas R J Ward, *Kt.*

C.I.E., M.V.O.

President 1920

The Institution was formally registered on 13 September 1920 in Madras under Indian Companies Act, 1913. Necessary permission was later secured to establish the Registered Office at Calcutta. Sir Thomas R J Ward, Inspector General of Irrigation in India [Inspector–General of Irrigation, India. (Retd. Jun 1921)], who was the Chairman of Organising Committee of 'Indian Society of Engineers', became the first President of The Institution of Engineers (India). His tenure was curtailed due to his retirement from India. He resigned and was succeeded by Sir Rajendra Nath Mookerjee who took over as the Inaugural President of the Institution on 29 November 1920.

Sir Rajendra Nath Mookerjee

K.C.I.E.

President 1921-22

The Inaugural Presidential Address

I desire in the first place to express the thanks of this Institution to Your Excellencies for your presence at this our inaugural meeting. I venture to infer from Your Excellencies' acceptance of our invitation to attend this meeting and His Excellency the Viceroy's consent to sign his name on the roll as the first Honorary Member, that Government considers that the Institution is meeting a national need of high importance by uniting in a single body all classes of professional engineers in this country.

The Institution of Engineers (India) which came into being on 13th September, 1920, is the result of a general desire of those engineers in India who are members of the great parent Institutions in England, the Institutions of Civil Engineers, Mechanical Engineers and Electrical Engineers, to forma which corporate body should safeguard their interests, provide means of exchange of views on professional engineering matters and a medium for expression of authoritative opinions on engineering problems of public interest. Local Associations of engineers in India have been in existence for some time, but the need for a strong central body was brought out in the report of the Indian Industrial Commission. The idea took definite shape under the guidance of Sir Thomas Holland at a conference which took place in Calcutta early in 1919 and the first provisional constitution was then drafted. Since then those who were responsible for organizing the Institution have worked assiduously to bring about the desired result and have now overcome all the difficulties which stood in their way. The difficulties have been great and one of the greatest has been the size of the country and the length of time taken to consult prominent engineers in all parts of India. It was recognized that the Institution to fulfil its functions must take full advantage of the work already done by the various local associations and make it possible for them to preserve their independent existence while obtaining close attachment to the Institution. It is to Major Willis that we owe the device now included in the Articles of Association by which the relations between the Institution and its Local Associations is to be defined and it will, I believe, be agreed by all that this will, on the one hand, provide for the continuance of a vigorous individuality in the Local Associations, assisted when required by the influence and organization of the central body; while on the other hand the Institution itself will derive strength from its connection with the various local bodies which now exist and others which it is hoped will arise in the course of time.

I wish to lay special stress on the all-India character of this Institution and the fact that its membership is designed to include all professional engineers of whatever particular branch, irrespective of race and creed, colour or political views. Its representative nature can be clearly seen in the of the first Council. composition It is in the highest degree satisfactory that our Institution has been brought into being with the blessing of the three great parent Institutions of Great Britain. It is our earnest hope that government will further assist in establishing the status of this Institution by lending their influence to obtain a Charter of Incorporation such as has been granted to one of the great engineering institutions to which I have referred. India has owed much to her engineers in the past, and I confidently predict will owe a still greater debt in the future. As an Indian, I should like to take this opportunity of acknowledging the spirit of comradeship and cooperation in which British engineers have extended the hand of fellowship to their Indian colleagues. We, Indian engineers, are the gainers by this association, and we must make it our duty to see that participation in its interests is to the advantage of this Institution.

I beg Your Excellencies to consider the present assembly and for what it stands. Never before, I think, have the Viceroy and the provincial Governor been present at such a gathering of engineers. Those who are present today are representative of all parts of India and of every branch of the engineering profession: engineers who have designed and constructed our railways, who have conceived and executed vast irrigation projects unequalled throughout the world, and who are responsible for our electric installations and our water works, drainage, roads and buildings, and for the erection and working of the great industrial and engineering workshops of India. They are the servants of the great public interests, whether controlled by Government or by commercial people, and they attain a common object by methods, of which the principles are the same, however diverse may be their application. Even in this country sheltered from the strife of war, it has been demonstrated what the world owes to engineers, and most of the troubles that were experienced here, were due to war conditions interfering with engineers' working requirements. On the other hand, the engineering profession showed how, in spite of insufficient and make-shift equipment in many cases, it was able to produce large quantities of articles needed for war purposes many of which no one had ever before thought could be made in India and at the same time to carry on engineering works of public importance under conditions of very great difficulty. To engineers difficulties appear only as obstacles to be overcome.

India possesses its own peculiar engineering problems, largely due to the seasonal character of its rainfall, rendering agriculture precarious without irrigation, and hydro-electrical schemes impracticable without storage. Further problems arise from the vast area covered by the Indo-Gangetic alluvial and from the Deccan trap, by the unequal distribution of coal, and the absence of navigable rivers in the peninsular area.

The development of the material resources of India has hitherto been retarded by the slow progress which has been made in establishing engineering industries in this country. In recent years, the commercial success which hasp attended the operation of modern blast furnaces and steel works has opened out a big field for further development in metallurgical industries of every kind, in which so far very little has been done. The manufacture of machinery in this country is still in its infancy and the big textile industries like those of jute in Bengal and cotton in Bombay are greatly hampered by reason of the fact that their base for the supply of manufacturing plant is still 6,00 or 7,000 miles (about 9700 or 11300 km) distant. There is not the least doubt that the long lead which Lancashire obtained in the cotton industry and Dundee in jute, is due to the very close connection which exists between the mills and the engineering workshops where the plant for these mills is designed and manufactured.

Gentlemen, India has for the past three quarters of a century been a country in which some of the greatest triumphs of Civil Engineers have been won—triumphs, perhaps, too little appreciated by the world, owing to the unostentatious manner in which such works have been conceived and carried out. But an equally magnificent field is open to the electrical and mechanical engineers who are beginning to show their quality in the great hydro-electrical schemes, some of which have just been completed, and others just starting, connected with the industries of Bombay and Calcutta, and the coal fields and mining areas. They have done enough to show that they are worthy successors and comrades of engineers like Sir James Wilson, Sir John Benton, Sir Bradford Leslie, Mr J R Bell and a host of other capable and gifted engineers who have been or are at present in India.

While recognising the debt which India owes to Engineers, we have to give a high place to their work in constructing and maintaining the great system of railways, which not only encourages and stimulates intercourse between widely separated communities and races but also links up the great commercial and industrial areas of the country and provides the means whereby the effects of periodical scarcity are averted, raw materials are brought to our industrial centres and manufactured goods are distributed to the consumers. The railways of India form an asset both real and potential, the like of which is possessed by no other Government. By the wisdom of those who laid down the railway policy of the past, the State, that is the people of India, have become possessed of these great railways which have cost between 100 and 400 million sterling and which while performing their proper function as means of communication, bring in a steady annual income to the Imperial Funds. It is well known that a forward policy in railway development is necessary if the industrial, commercial and social needs of the country are to be satisfactorily met, and on railway engineers will fall the task of designing and carrying out the railway extensions and improvements of the future for which it is hoped the necessary financial arrangements will be made.

It is hardly too much to say that the whole industrial development of India in the future depends on adequate provision being made for improved transportation facilities; and the special railway engineering problems of India will consequently be amongst the most important with which this Institution will be concerned.

The material prosperity of India will be greatly increased if more efficient use can be made of its vast stores of subterranean water. This is essentially an engineering problem which will certainly be solved if it is seriously and continuously worked at. The final result is hardly likely to be the product of a single brain but may be arrived at by a process of evolution.

State socialism is more prevalent in India than in any other country, as evidenced by the State ownership of railways and canals, of forests, of much of the land, and by the creation of such State monopolies, as salt and opium. India can make good its claim to local autonomy by, amongst other essentials, providing for the effective control of its industries and its engineering activities. Our new- government involves an expensive administration, which makes it all the more vital that the resources of the country must be adequately developed. India abounds with immense natural wealth and, given cooperation between all political parties, is a country with unlimited industrial possibilities. The development of a nation's resources depends upon the exploitation of the forces of nature and natural products by skilled engineers. Industrial progress is only possible through engineers, supported by adequate financial power, and this newly formed Institution will prove a powerful and effective organization to promote the efficiency and training of Indian engineers, without which the unrivalled resources of India cannot be developed to the same extent as in the more advanced parts of the Empire.

India to-day is in urgent need of an adequate supply of practical engineers. Indians and Europeans are alike beginning to realise that the development and salvation of Indian industries depends upon the training of expert engineers in India. The newly awakened interest in engineering in India is due to the realisation of this fact, and only now is the value of science as a means of promoting the success of industry beginning to be realised. With the rapid advance of science applied to industry, the importance of engineering training becomes greater and greater. Full and adequate means of obtaining a practical and scientific education is a most important factor in achieving national and economic success. It is of the utmost importance that those who are in any way concerned in the development of Indian industries, should take the matter of practical training of engineers in India into their serious consideration. We engineers, therefore, in addition to the actual practice of our profession, are also actively interested in the training of the rising generation in India. In Bengal we are grateful to His Excellency Lord Ronaldshay in as much as, during the past two years, a great step forward has been taken in this direction by the Government of Bengal. But much remains to be done and I hope that this Institution will keep alive the interest of the profession in this important matter, and lend its support to all well considered efforts to improve the training of Indian Engineers.

A very important function which it is hoped that the Institution, with the approval of the Government of India, will shortly undertake is the work which is required in India in collaboration with the Engineering Standards Association, which has done so much to prescribe and promulgate throughout the Empire a definite system of British Engineering Standards. It is hoped that the Council of the Institution will be entrusted with such portions of this work as are peculiar to India and that this will result in valuable assistance being given to the cause of standardization in all branches of the profession.

Though the Institution is a non-political body, it must largely interest itself in administrative and economic questions and its members should be in a position to assist the State and local administrations such as City Corporations, District Boards and Municipalities in respect of industrial activities and engineering schemes for water supply, sanitation, electricity, railways and district roads. It is desirable that engineers should exercise a more effective voice in the administration of the country than has hitherto been the case, and with their specialised knowledge and experience they should not be content with representation in the Councils by men outside their own profession.

Such, Your Excellencies, are the objects for which this Institution is formed and such will be the work the members of the Institution will have to do. This Institution will, I confidently hope, grow with the advance of time and keep pace with the industrial expansion of India and, by its work, stand firmly established in the confidence of the people and the respect of the world. A full member of this Institution will be entitled to add the letters MIE (Ind) after his name, which we all hope in time will come to be considered as the proudest addition that an engineer in India can add to his name. This distinction cannot be obtained by favour or money. It can be held only by a qualified engineer and earned by meritorious and distinguished work.

Under the patronage of Your Excellency's Government, this Institution cannot but be productive of great good. Not only will it go to promote *esprit de corps* in a most necessary profession, but it will encourage engineers—civil, mechanical and electrical— whose work lies in more distant parts of the country to meet together periodically.

The founding of this Institution has come at an opportune moment to show that all who are followers of the great science of Engineering in all its branches are labourers in a common cause, that all are united in applying the forces of nature to the service of man, to making life less laborious, safer, more productive, more effective and happier. The day is not far distant when engineering questions of public importance will be referred to this Institution for advice and will be settled by its decisions.

For another reason too the founding of this Institution is opportune. It forms a bond of union between Indian and European Engineers by reason of their common task and traditions as well as their community of interests. The most enlightened Indians and Europeans both recognise that the hope for industrial India lies in hearty cooperation. India is now taking the first great step towards the goal of National Self determination, and it is a happy augury that in the founding of this Institution Englishmen and Indians stand side by side, hand in hand with the masonic grip of fellow craftsmen to showthat they, who tyle the Lodge of Engineering Progress in the East, are ready to share with their Indian brother engineers, the glorious task of securing the country against famine, of increasing the value of its resources by improved communications, of harnessing its water-falls and of turning its wealth of raw materials into finished products and bringing contentment and plenty to its teeming millions. Enthusiasm, firm resolution and a keen desire to justify our position will help us to work together. Science and art are the great means of making social union, and their modest and silent work contributes to bring harmony between diverse nations amid the din of political strife. Gentlemen, with this happy union of art, science and races I foresee the brightest future for our Institution and may the inauguration by His Excellency the Viceroy today be an omen of a continuous career of success.

Before resuming my seat I consider it is my duty to make my personal acknowledgments on the occasion which has brought us together today. I am painfully sensible that I very inadequately fill the chair which I occupy, yet I can honestly say that I have never waivered in taking a keen and active interest in the progress of engineering science in India. No recognition of efforts of mine, which I have ever received from Government or from the public, has given me so much pleasure as the high compliment you have paid me in electing me your President—an honour which was generously and spontaneously bestowed by you. I find it beyond my power of expression to thank you adequately and I say with all sincerity that there is no institute or association to which I am prouder to belong than to this INSTITUTION OF ENGINEERS.

It is now my proud privilege and pleasure to invite Your Excellency to inaugurate the INSTITUTION OF ENGINEERS (INDIA).

Sir Rajendra Nath Mookerjee—a Brief Profile

It is historical inevitability that the Institution had elected Sir Rajendra Nath Mookerjee as its first President who is remembered for creating a heritage of applying 'force of Nature to the service of Man'. Sir Rajendranath was born on June 23, 1854 in a typical middle class Bengali family. He lost his father when he was only six and was compelled to give up studies as he was to look for a job to support his family.

A chance meeting with Mr Bradford Leslie, Chief Engineer, Calcutta Corporation, earned for him the contract for the entire extension and plant maintenance work at the Municipal Waterworks at Palta, north of Calcutta. He then joined Thomas Acqu in Martin and through him the firm of contractors secured a number of important assignments for urban water supply in the country.

He got the work of building a wide network of light railway links with important railheads in as many as five states. This network of railway link approximately covered 475 km of railway track and immensely benefitted India's rural economy ensuring communication with the Indian villages.

In 1927, the Martin & Co acquired the old established' engineering firm Burn & Co and launched into the field of Civil Engineering and building construction. Under the able guidance of Sir Rajendra Nath the Company's fame as a pioneer firm of architects and builders quickly spread across the land and even overseas. Within less than twenty years of its birth, the Company earned the prestigious structural and civil engineering work of the great 'Victoria Memorial', which is ranked as one of the world's finest architectural achievements.

Sir Rajendra Nath was elected Sheriff of Calcutta in 1911 and honoured with a Knighthood in the same year. In 1922, Sir Rajendra Nath was conferred KCVO (Knight Commander of the Victorian Order) for successful execution of the Victoria Memorial Building. |

Earlier in 1916, the Government of India set up the Industrial Commission with Sir Rajendra Nath as a member. Later Sir Rajendra Nath acted as the Chairman during the absence on leave of permanent incumbent Sir Thomas Holland. The idea of setting up a central organization of Indian engineers was mooted in his mind at this time. At last his deream came true.

On September 13, 1920 the Institution of Engineers (India)came into being and Sir Rajendra Nath became its first President on November 20, 1920.

Sir Rajendra Nath breathed his last on May 15, 1936.It was less than one year earlier that the Institution was granted the much awaited Royal Charter. Sir Rajendra Nath's dream became a reality.

Though not physically present, Sir Rajendra Nath has been ever- living with the Institution. We hear his 'footfalls' when we repeat the words he delivered during the inaugural address. 'The day is not far distant when engineering questions of public importance will be referred to this Institution for advice and will be settled by its decisions'.

The death of Sir Rajendra Nath at the grand old age of 82 was, however, a great loss to the Institution. A memorial fund styled 'Rajendra Nath Memorial Fund' was opened and generously subscribed. A marble bust of Sir Rajendra Nath was erected in the Institution Hall in 1940 and unveiled by Maharajah Srish Chandra Nandy of Cossimbazar on February 27, 1941.

Lt. Col. G. H. Wills

C.I.E., M.V.O., R.E.

President 1922-23

Presidential Address

GENTLEMEN,

Your Council in their wisdom have elected me as President of your Institution for the coming year.

In so doing they have conferred on me a very great honour; and you, members of all classes of the Institution, have endorsed their choice by the generous applause with which you greeted the notification of my election by our Council. I thank you all most heartily for the great compliment paid me, and assure you that so far as in me lies I shall strive to prove myself worthy of your trust.

Later, when the Institution has reached a more mature stage, you will doubtless find that it is a pleasant luxury to confine your election of Presidents to men of outstanding attainments. Such men—and among them I include our two past Presidents—at this period of our corporate life must be an almost unattainable luxury, as their energies are all necessary in the economic progress of the country, and it would be wrong to ask them to sacrifice their scanty leisure to the careful, slow, constructive work—with the necessary trial runs and (we hope) no more than very occasional and minor breakdowns—which will ensure that our Institution shall be an efficient, enduring and improving machine.

Later you will be able to honour these outstanding engineers by electing them as Presidents; and they will be able to honour the Institution by accepting the high office, knowing that they hare to their hand a mechanism which is in good running order in all its parts and only requires their general supervision and guidance.

I succeed to a very distinguished man in our late President— Sir Rajendra Nath Mukerji—and it is my great regret—for the sake of the Institution—that his multifarious and very important other duties have prevented him from presiding over us for another year as he might have done under our constitution.

As you know, gentlemen, his work on the Railway Commission took him on a long visit to England and deprived us of his personal guidance for a substantial part of his term of office. But I can testify from my own experience—and my friends on the Council. who have been in closer touch with him than I, will I am sure bear me out that his weighty counsels, his large views, and his real interest in our Institution during its first year—a very difficult period—have been of inestimable value to us.

We regret the termination of his year of office; but that regret is tempered by the fact that his retirement therefrom is, *inter alia*, due to the necessity—as a public man—of accepting the very important post of chairman to the Committee on the Howrah Bridge. In this work he will be associated with others of ow Council—in fact I believe I am right in stating that every member but one of that Committee is a member of our Institution.

At this point it may be of interest if I expand a little the Annual Report which you have just heard read. That report only deals with what has happened before the 1st September last— the end of our Institutional year. Since that date there have been notable developments.

A specific request from the Engineering Standards Committee at home has been addressed to us regarding the revision of the specification for steel rails. A committee is in process of formation to deal with this matter, to which Government will appoint certain representatives. This work will be pushed on as fast as possible consistently with thorough work. As you will readily perceive, it is a matter of great importance to the steel industry in this country as well as to the railways that a sound working specification should be arrived at as early as possible. It is probable that the headquarters of this committee will be on the other side of India since it is on that side that the steel works are situated and are always likely to be situated.

Then the formation of another committee to draw up a standard specification for Portland Cement for India is under consideration. It seems probable that if this committee be formed it will be found that most of the work can be done on this side of India, where so much ferro-concrete construction is in progress and where the management of several large cement works have their headquarters.

The Government of India in addition to entrusting the work on Engineering Standards for India to our Institution is preparing to hand over to us that of the Electro-Technical Commission also when we have completed our third year of existence as a corporate body, this being one of the essential qualifications for a society undertaking the task. In the meantime they have nominated a committee of three of our Council—Messrs. Coubrough, Cochran and Hindley to deal with the subject.

Further, you will be interested to learn that one great corporation— I am not at liberty to give names—employing many engineers, has decided to insist on all its junior engineers qualifying for Associate Membership of the Institution either by passing our own examination for Associate Membership or such, other examinations as the Institution may accept in lieu thereof. The preliminaries for instituting our examination are now in an advanced stage.

These, gentlemen, are only beginnings in the vast sphere of usefulness to India and to our profession which we—as an Institution—hope to fill. They are of good augury, as it is by the recognition of our Institution in this manner by Government, whether Imperial or Provincial, by employers of engineers whether corporations or individuals, and by the public, that the Institution will move forward into'the place it should and must naturally take in the economic advancement of India.

Let me now draw the attention of the Institution to your indebtedness to those who formed the working committees of your Council during our first year of being. They have shouldered real hard work and great responsibility. We are, I am sure, all most grateful to them. I am very glad to see some of those to whom I refer here with us to-day; and others who are not here will doubtless consider your approbation (just expressed) their full reward, since they have all worked selflessly for the good of the Institution.

Since the last meeting we have lost the services of our first Secretary—Mr. Brady. I had exceptional opportunities of seeing his Carly work and wish to bear testimony to the very conscientious whole-hearted labour he put in. The Institution owes much to him and I shall have you all with me in wishing him well in his new appointment.

Many of you have already received the first copy of our journal. This has been a long time in the making owing to various causes, some of them unavoidable. It is confidently hoped that future issues will appear very much more quickly, and at reasonably frequent intervals throughout the year. I mention this in order to draw the attention of members to the good which they can do for the Institution by bringing their copies to the notice of public bodies and firms and individuals interested in engineering, though not themselves engineers, with a view to enrolling them as subscribers. The subscription is only Rs. 50 a year, and entitles the subscriber not only to all copies of, the journal but also to attendance at all technical meetings of the Institution and also of the Local Association of the Institution of the district in which he resides.

The matter of the qualifications to be required from those wishing to become Students of the Institution is receiving very careful attention and it is hoped very shortly to lay down final rules. Some students undoubtedly possessing suitable qualifications have already been admitted. We should all of us use our best endeavours to extend this branch of our membership as an important factor in the growth of our Institution, since from the students will eventually come the main body of our membership.

Here I wish to draw the attention of those concerned to the unreason of refusing election to the Institution as Associate Members because applicants think they are qualified to be full Members. The Articles of the Institution lay down the qualifications for the various grades of Membership strictly—and the Council is bound to interpret them with strictness—and does so without fear or favour. Those who for various reasons are found by the Council to be qualified for Associate Membership and not for Membership i should be glad to recognise that the Council are striving to do their duty to the Institution and to ensure its high standing not only in the present but for the future. It is surely far better to be an Associate Member in an Institution which rigidly insists on if high qualifications than to be a Member of an Institution whose governing body is lax in this respect. The man who is elected an 4 Associate Member has only to qualify himself by more lengthy experience on more important work before the Institution will welcome him to Membership, and the time that this takes will often rest very largely with himself.

A further point which our Associate Members may well remember is that, except for the payment of lower entrance fees and subscriptions—and this can hardly be counted a hardship in these times—they are in no way disadvantageously placed in regard to Members. They are full corporate members of the Institution and their votes carry individually the same weight as those of Members.

The Institution is greatly indebted to the Government of India, certain of the Provincial Governments and to two of the great railway companies for allowing concessions in the matter of travelling to this meeting to those of our members serving under them. May I on behalf of the Institution express our gratitude for this evidence of their well-wishing. It is to be hoped that other Governments, and railways and also that large employers of engineers will in future years grant equal facilities, since it is not only for the benefit of the Institution but also for their own benefit that their engineers should be able to take part in the annual gathering. The diffusion of knowledge .and experience which results from meetings of engineers of all branches of the profession from all parts of the country must make greatly for efficiency, and should be encouraged in every possible way by all Governments and corporations taking a long view.

I now come to the matter that has been uppermost in my mind when thinking how best to fulfil the duties of the high office to which you have called me. The answer to that question undoubtedly is—to foster the progress of the Institution along the right lines—but that is a generalisation and like all generalisations not very helpful.

Ascending then to particulars—it seems that first and foremost comes the extension of membership of all classes until the Institution includes all qualified engineers in India. To this end, it is necessary to combat apathy and selfishness. We have all been confronted by the qualified man, whom we should like to bring into the fold, with two points—firstly, the question—‘‘What is the good of the Institution to me?’’; and secondly, the statement that “I cannot afford the high entrance fee and subscription.”

It may strike you that in this matter T am preaching to the converted but trust that our friends of the Press will wing my words to those for whom they are intended,

To the man who wants to know what the Institution is going to do for him, usually coupled with the information that he is member already of one or more of the British or American Institutions — I reply that his question is a topsy-turvy one. The real question should be —“Of what use can I be to the Institution ?’’ And it might with advantage be further extended — “Of what use have I been to the Institutions to which I already belong?”

The man who joins any Institution solely for what he can get out of it — whether by way of letters after his name and consequent better standing in his profession — or for the material benefits of a professional union — is not the real strength of an Institution and is not likely to further its progress to what he is looking for.

Our Institution can never become the professional power which every Institution worthy of the name aspires to be until a sufficient number of qualified men join its ranks determined to do all they can to make it what it ought to be.

The great engineers of the past who founded and guided to their present pre-eminence the leading Institutions in England were not mindful of themselves but of their profession; and so it has been with many and—I believe—most of those who have joined us so far.

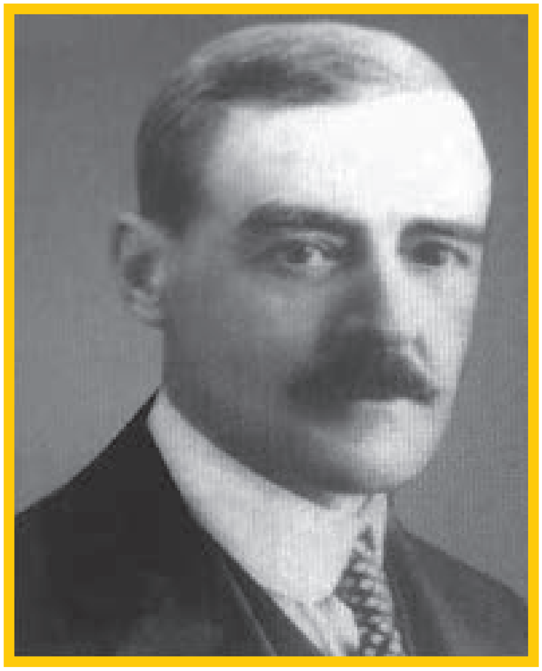
Next let me deal for a moment with the question of expense. ‘Nothing for nothing and very little for sixpence” runs the old saying, and since the war the ‘‘very little’? has become less. I do not think that—except in a very few cases of which all of us know some and we sympathise with them sincerely—any qualified engineer cannot afford the entrance fees and subscriptions laid down. The terms of payment have been purposely made very easy but the amounts cannot be reduced if the Institution is to be a living thing. After all what do these payments amount to? Rs.5 a month for a Member and Rs.4 a month for an Associate Member. The entrance fees are—I admit—substantial but they can be liquidated by payments spread over a period, and the amounts are such that most of those objecting would not hesitate to expend them in some less utilitarian manner.

The world is only going to go forward—in engineering matters as in all else—by the spirit of sacrifice; and here is a sacrifice, though I maintain only a small sacrifice, which all engineers worthy of the name should be willing and more than willing to lay on the altar of their profession for the ultimate perfecting of the spiritual temple of that profession in India.

This is the plain duty not only of Indian engineers who wish well to their motherland but also of those of us whose country it. is by adoption and who draw our livelihood therefrom.

It will be to those members of all classes who join us in the spirit of service and sacrifice that this Institution, and through this Institution India, will ultimately benefit incalculably.

Gentlemen, this is my faith and in that faith only I dare to take up the heavy but very honourable burden which you have Iaid upon me of being your President for the ensuing year.



Mr A C Coubrough

C.B.E.

President 1923-24

Presidential Address

GENTLEMEN,

I desire in the first place to express my thanks to the members of the Institution for the great honour they have conferred on me in electing me as their President. The Institution is still a new venture, and the energies of our Council are mainly concentrated at present on the development and strengthening of the Institution. If it were not for this fact I should not only have hesitated to accept the responsibilities which my present high office entails but should have definitely stood aside in favour of one or other of our many members who I feel are so much better qualified in many respects to be your President.

I look upon my position as that of the chief organiser for the time being of a professional movement rather than that of the figure head of a body comprising the great bulk of the leading engineers belonging to this: great country. I thank the members of the Institution and the Members of its Council for the confidence they have shown in me and for the tribute they have thus paid to me for the work which I have attempted to do on behalf of the Institution in past years.

HISTORICAL

I follow in the footsteps of men who, heart and soul, were imbued with the spirit of altruistic work: Sir Thomas Ward was our first President, his term of office was curtailed by his retirement, but his work for the Institution was done in the years prior to our incorporation. With no thought of self, with the knowledge that the date of-his departure from India was rapidly approaching, Sir Thomas Ward worked strenuously and enthusiastically for the good of the younger engineers in India to whom he left the legacy of an Institution in being, ¢ and an example to us all of high souled aspiration.

Sir Thomas Ward was succeeded at the end of 1920 by Sir Rajendra Nath Mookerjee. The debt of gratitude that the Institution owes to him cannot yet be measured. His services to India have led him far beyond the confines of Engineering activities. His name will be remembered in future years for his vast public services, not only to his Province, Bengal, but to the whole of India. I am proud to record the Honour of Knight Commander of the Victorian Order which he received at the hands of His Majesty last year. I think, however, that among the many recognitions which he has received for meritorious work, there are two which he must look upon with special pride, that of being elected an Honorary Member of the Institution of Mechanical Engineers and of having held the office of President of this Institution.

Our retiring President is Col. Willis. Those of you who have followed his work during his year of office know something of his value to our Institution. I can assure you, however, that in addition the Institution owes a very deep debt of gratitude to Col. Willis for the work which he did on its behalf during its early stages before incorporation and until he became President.

Those of you who join our now stable and progressing body, do not know, in fact can have little conception of, the critical times through which we passed when the Organising Committee was labouring to give birth to the Institution. We had troubles to meet at every turn, opposition to face from many quarters, criticism to meet from all sides and more difficult to counter than all the rest we had apathy where we looked for encouragement and fingers pointed at an Institution which some described as still-born.

During these trying times the man whose enthusiasm was never shaken, whose courage never failed was our late President, Col. Willis. I take this opportunity of thanking him on behalf of the members of the Institution for the valuable services he has rendered during his year of office and still more on behalf of the Council for the services which he rendered in the initial stages of the movement to form and incorporate the Institution.

I have spent some time in recording the work of past Presidents. I have done so because I can claim to be in a sense the oldest member of the Institution. I feel that at this early stage in the life of the Institution it is fitting to record the work of past Presidents and of those, who, with them, were responsible for bringing into being an Institution of which I think we can justly be proud.

I cannot leave this subject without reference to two more names, Sir Thomas Holland and Mr. J. W. Meares. Regarding the former I need say little in regard to his work for the Institution, as it is already recorded in our Annals. I should, however, like to express the personal gratitude with which I look back to my association with Sir Thomas Holland when he was Chairman of our Organising Committee. The compliment which you have paid me to-day in electing me your President is a compliment to him, for I feel that without his assistance in the early days I could not have sufficiently gained your confidence to justify you in selecting me for the highest office in the Institution.

Mr. Meares is another old and well-tried friend of the Institution. I can safely say that only his retirement from India last year prevented him occupying the position which I hold to-day. Although absent from India I am glad to say that Mr. Meares is not lost to the Institution. I had the pleasure of meeting him in London last October, and his interest in our work is still as active as it ever was. He is engaged at present in seeing to the preparation of our diploma. I hope that during the present year all our members will receive their diplomas, and then realise that. in entrusting their preparation to Mr. Meares the Council has acted wisely.

THE YEAR'S WORK

From matters which are more or less historical I would now like to direct your attention to the

Annual Report which has already been circulated. This report indicates in brief form the work in which the Council has been engaged during the year ending on the 31st August, 1922.

The Council has two main duties to perform. One to increase the strength and stability of the Institution and the other to increase its usefulness and influence. These two main functions are looked after by two Committees, the Finance Committee and the Administrative Committee.

Under the guidance of the Finance Committee the Institution has during the year, materially improved its financial position. Our expenditure is still in excess of our revenue and we have accordingly a growing deficit. We should like to have seen at the close of last year our membership reaching a total of 700. At the close of the present year we should like to see a membership of 800, I see no reason why our membership should not greatly exceed that figure. We have in India about 600 members of the Institution of Civil Engineers, about 400 members of the Institution of Electrical Engineers and about 400 members of the Institution of Mechanical Engineers. At a guess I should say that there must be at least 1,000 qualified engineers who are not members of one or other of the British institutions. We ought therefore to have little difficulty in raising our membership to 1,500 or 2,000 in the course of the next few years.

Our aim is to enrol every qualified engineer and thus to make the membership of the Institution a necessary qualification for all professional engineers in India. We shall be paying our way with a membership of 800, every addition beyond will enable us to have funds available for increasing the activities and usefulness of the Institution.

I hope that members will make a special effort during the present year to interest those, who have not yet joined our body in the work of the Institution and get them to apply for membership. We are making good progress. We consider on an average twenty applications a month but we wish to speed up our rate of progress. We wish especially to enlist the support of those who employ engineers. We have a class of subscribers which we invite them to join. We hope that all Departments of Government, both Imperial and Provincial, interested in engineering in any shape or form will give us their support by joining our Institution as subscribers, and we hope that all similarly interested firms and public or semi-public bodies will do likewise.

We have a fairly expensive central organization but this organization is the key to our success. The history of similar movements in the past in India has demonstrated that without a strong central paid organization, no continuity of policy and no progress can be made. In fact, I would go further than this and say that without the strong central organization the Institution would in a few years time languish and die. We must run our Institution on sound business lines if we are to be successful, and I make no apology therefore for drawing attention to the need for support of both a moral and material character.

The work of the Administrative Committee is allied with that of the Finance Committee in that it supervises the activities of the Central Organization. The Council lays down the policy to be followed, the Administrative Committee sees that whatever is necessary to carry out that policy is done.

I have made this somewhat lengthy explanation because those of us who have been working in these Committees realise that members in different parts of India and even members of Council in parts of India remote from our headquarters, have few opportunities of learning what the Institution is actually doing or how it is carrying on its work. The Council meets at regular monthly intervals and the Committees more freequently when necessity arises. These meetings are faithfully attended by all those within reach of the place of meeting. I think that some times members lose sight of the amount of work which the Council and its Committee members have to carry through.

We had a proposal put forward last year to issue a monthly or quarterly Bulletin, so that we might try and give members a better insight into the work of the Council. This proposal was negatived solely on the ground of expense. We have to cut our coat according to our cloth. I hope, however, that during the present year, if our membership progresses favourably, that we Shall again be able to give this proposal consideration. I am personally of opinion that the issue of more frequent information to members is a very necessary part of our work. At present our Annual Meeting and the Annual Meetings of our Local Associations are the only occasions, apart from the issue of the Journal, when the Council has an opportunity of letting members know how the Institution is progressing.

I am glad to be able to report good progress on the part of our existing local Associations during the past year. The Calcutta and Bombay Associations are proving real centres of engineering activity. Still more am I glad to report the progress that is being made in the formation of new Associations.

At this our third Annual General Meeting we meet in the historic city of Lucknow under the aegis of and at the invitation of the United Provinces Association, and I wish to compliment this Association on the pride of. place which they have thereby earned for themselves in the annals of our Institution. I know that one of our difficulties in future years will be to decide the order of precedence of our local Associations. Already this year we had to refuse a cordial invitation from Madras, because the technical formalities in connection with the formation of the South India Association had not been completed.

My predecessor did most useful work in touring the various centres where our Institution has active life. I am selfish enough to hope that I shall reap the fruits of his labours during my year of office. I hope that I may be able to hand over to my successor the charge of an Institution embracing local Associations, not only in Bengal, Bombay and the United Provinces, but in South India, the Punjab, Mysore, Bihar & Orissa and perhaps in other centres as well.

EXAMINATIONS

There is just one more subject in connection with the development of the Institution on which I think a few remarks are necessary, namely, examinations. As you are aware it is laid down in our Articles of Association that candidates for admission either as students or Associate members or in most instances as members shall have passed an examination.

It has been the aim of the Council to maintain the examination standard on a level with that of the great British Engineering Institutions. The Council has however been faced with the difficulty that many engineers in India holding responsible positions had not the necessary examination qualifications, and the Institution had not arranged for its own examinations to be held.

Steps were therefore taken to draw up an examination syllabus with a view to' examining candidates on their general and technical knowledge. This syllabus was prepared last year and has undergone a very complete scrutiny by those best qualified to give advice to the Council regarding it.

It is proposed during the course of this year to form an Education Committee of the Council to whom this syllabus will be handed over. It is hoped that examinations will be organised at any early date, and all candidates not exempted therefrom by other qualifications will be asked to pass these examinations before election.

In regard to this question of examinations I had a most interesting conversation in October last with Dr. Jefcott, Secretary of the Institution of Civil Engineers. From him I learnt that the British Engineering Institutions are endeavouring to bring their examinations into line with each other. This is a most important step from our point of view. If the Home Institutions combine forces in regard to examinations it may be possible for us to obtain in India copies of the papers which are set for these examinations at regular intervals. A student or an applicant for Associate or Full

Membership could then sit for this examination either in England or in India, and the passing of this examination would exempt him from any further educational tests. The Council of the Institution will I feel sure welcome such an arrangement not only from ,the point of view of fixing a definite standard of examination qualification, but also because it would be the means of establishing a definite link between our Institution in India and the great Institutions at Home.

During a course of a few weeks visit Home last October, I had the pleasure of meeting the Secretaries of the Institutions of Civil, Electrical and Mechanical Engineers, and also the President of the Mechanicals Dr. Hele Shaw. I am sure it will be a source of gratification to all our members to know that the Home Institutions not only know of the existence of our Institution but express keen interest in its welfare and progress.

The opinion was universally expressed that as far as it was possible to judge from our Constitution and publications we had started in the right lines. The Home Institutions are most anxious that we should maintain the high standard of professional qualification which we have set out to obtain. I feel sure that we can look with confidence to receiving from the venerable Institutions, whose example we are trying to follow, help, encouragement and if guidance we ask for it.

With the support which we have had from the Government of India and from our kindred Institutions in Great Britain it is our own fault if we fail to press forward to the attainment of the high ideals which we have set before us.

Let me at this juncture make an announcement on behalf of the Council, The prize presented each year by His Excellency the Viceroy for the best paper submitted to the Institution during the year has been awarded to Mr. D. G. Harris for his paper "Irrigation in India". The prize presented each year by the Institution of Electrical Engineers for the best paper on an Electrical subject. has been awarded to Mr. Lennox Stanton for his paper " Railway Electrification."

THE FUTURE BEFORE THE ENGINEERS IN INDIA

I now ask your forbearance a little while longer while I try to visage the growing importance of the Engineer in India under the fatherly care of our Institution.

The Prince of Wales in a speech at the Guildhall on October 20th said "It is to the Industries of India, with its untold possibilities of development that I look for the moral and material progress that we wish for the peoples of that great land."

Gentlemen, from time to time there have been pronouncements and announcements by politicians and others as to what Great Britain was going to do to India or for India, what India was to have or not to have. We have heard much of diarchy and anarchy, of co-operation and non-co-operation, of Reform Schemes and Ghandi-ism, of the needs of Manchester and the boycott of piece-goods, and all this talk passes the engineer by as the exhaust of a motor-car—like the: idle wind. It is not the fumes that interest him but the hidden engine which produces them.

I venture to suggest that the simple words of the Prince of Wales have more fundamental truth in them than the oratory of all the Statesmen in the British Parliament. "It is to the Industries of India that I look." It is not to the words of those who say what they are going to do for India but to the deeds of those who are making India that the Prince turns our gaze.

Gentlemen, do you realise the import of the Prince's words for each one of us here to-day. Do you realise, as he has evidently done, that what H. G. Wells aptly calls the Mechanical Revolution has started in India? Do you realise that India is on the thresh-hold of her real internal development and that at the heart and core of that development is the Engineer?

Look at the history of the world since the Mechanical Revolution started. Look at the progress made by Western Nations since James Watt developed the Steam Engine. Look at the progress of an Eastern Nation—Japan—since that nation started colleges to teach engineering to her students. Look at the progress of America, a country more highly developed than any other in the application of mechanical appliances to the needs of every day life. Look lastly on India and see if the Prince of Wales has not held up before-us the touch-stone of progress.

India is becoming a manufacturing country. The natural wealth of India for manufacturing purposes cannot lie dormant for ever. Neither Manchester nor Mr. Ghandi can stay the normal course of evolution. I have read speeches made by short-sighted people in Manchester in which reference was made to the suitability of the climate of India for growing jute and cotton, tea and sugar, rice and wheat. Let India stick to her agricultural pursuits says Manchester and we will buy her produce.

I have read statements made by Mr. Ghandi in which he likewise deplored the growth of manufactures in India. Let India go back to the days of 100 years ago says Mr. Ghandi. Let us tear up the railways, burn down the mills, destroy the irrigation works and all the other machinations of the engineer and the devil. Let us clothe ourselves if we can and go naked if we cant, let us produce food for ourselves if we can and die if the monsoon fails us.

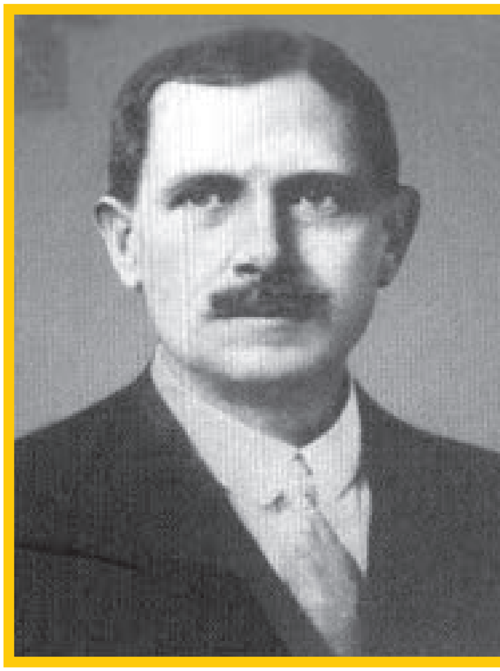
Will India follow Manchester and Mr. Ghandi or will it follow our noble Prince and look to the industries of India for moral and material progress? The formation of the Institution of Engineers is the reply which India has already given. The words of the Prince of Wales are these which I would like you all to carry away from the meeting to-day as your watch word.

We the engineers of India have had committed to us the high ideal of advancing India on its path of moral and material progress. We are not politicians, but we have all some stake in the country of our birth or adoption. We therefore must work, and if necessary by political means, for the good of India by the development of its industries. The engineer is essential for that development. The future of the engineer looms large if he truly perceives his destiny.

Let us all work humbly, steadfastly, honestly. Our profession essentially calls for accuracy in measurement and precision in thought.. Even our approximations are defined by stated margins. For our finest work we have "go"? and "not go" gauges.

As with our technical and practical work so it should be in all our professional and business methods. The qualities of our profession can only be acquired by careful early training and constant striving after an ideal.

It is for the older members of our profession and particularly for those who control the affairs of our Institution to see that the standards which. we set before the youth of India are those which embrace the highest ideals of engineering practice and the highest ideals of professional conduct. On such a foundation the future of our Institution will be securely built.



Sir Clement D M Hindley

President 1924-25

Presidential Address

I must first express my thanks to the Council of this Institution for electing me as your President for the ensuing year. It is an honour which I very highly appreciate although I would rather have seen the post of the President filled by some one more distinguished in our profession. I need hardly say that during the coming year I shall endeavour, with the assistance and cooperation of the Council on which believe I can confidently rely, to carry out to the best of my ability the responsibility which the position carries with it.

I should like to explain why I consider it an honour and what are my ideas about the responsibilities of my office. In the first place, Lam the successor of a line of distinguished Engineers who have filled the post and have guided the Institution through its early days; men whose work for the Institution I know from personal cantact and who have given their time and energy ungrudgingly in the service of the Institution. I am honoured in being classed with them and found worthy to carry on their work.

Secondly, the Institution, although young in years, has already established its position as the central organization of our professional purposes in India. It is no exaggeration to say that the Engineers in India, both by their historical achievements and the high standard of their professional work, stand second to those of no country in the world. If the history of Engineering in India is ever written, so as to comprise not only the comparatively recent introduction of western knowledge and methods, but the whole record of effort and achievement from the earliest times, it will be seen that the Institution succeeds to a heritage of which no Engineer of the present day, however great his professional achievements, can fail to be proud. The Institution is the representative of the profession in India and will before long, we hope, have on its membership rolls all who are qualified to practise as Engineers. Every member, therefore, should be proud of being connected with a body which thus forms a close and visible link not only with the great records of the past, but with the Engineering work which is going on in every part of this great country at the present moment.

Attainment to the position which the Institution holds to-day in India in itself carries with it obligations and responsibilities as regards present and future Engineering work in India and towards the present and future of our profession. We are in duty bound to the see to it that we use our position to establish standard of professional work, standards of professional qualifications and standards of professional conduct which shall be worthy of the past of the profession in India and not one whit below those of any other country in the world.

It cannot be denied that a realisation of this obligation carries with it a heavy sense of the responsibility which devolves on the Institution, and it will be my duty, while I am President, to endeayour to secure this realisation in the minds of all our members. It is only by a great corporate effort based on a sense of corporate responsibility that we can hope to move forward to the object with which the Institution was founded.

We have as an example the ever-increasing work which is being done by the great parent Institutions in Great Britain in the direction of maintaining and improving the standards of the profession and I am glad to say that we have uniformly succeeded in obtaining their sympathy in our efforts. There is no question of rivalry for we believe that those Institutions realise that our aim is to carry on in this country work similar in conception to that for which they are working and which they are prevented by distance from attending to in detail. It should be our constant endeavour to show in all our actions that we, as a young Institution, are worthy of the coufidence which we believe the older Institutions have in our efforts.

The Engineering profession owes a great debt of gratitude to the parent Institutions in Great Britain, for the ideals which those Institutions have always kept before Engineers throughout the Empire have been the main factor in establishing the high reputation which British Engineers hold in every quarter of the globe. The influence of these ideals and the practical application of them may be found underlying all modern practice in Engineering, in schemes for education and training and in conceptions of professional conduct. In no country perhaps more than in India have Engineers cause to be grateful to the parent Institutions for the steady adherence to these ideals, and for this reason the Institution of Engineers (India) will always be bound by ties of gratitude and loyalty to the great Institutions of the Empire.

The establishment of an Institution of our own in India is in keeping with advances which are being made in other directions towards making India self-supporting and is of the greatest importance to the profession and to India itself. The inauguration under the auspices of His Excellency Lord Chelmsford in 1920 in fact marks an epoch and is full of promise for the future. It was the expression in concrete form of a determination to establish in India a centre for a permanent and abiding effort towards maintenance of the same high standards, towards the preservation and inculcation of the same ideals as those which have made our profession what it is to-day. The Institution is to be the centre for effort and the repository of standards for the profession of the future in India. A high ideal, you will say, and one difficult to attain. One which will tax to the utmost the energies and capability cot those in whose hands the direction of the Institution will lie. But no ideal is worth striving for unless it is a high one and one which requires effort to attain. If it is an ideal worthy of acceptance it will carry with it its own inspiration and provide its spur to effort.

If we can ensure that every one of our members bears in his mind an appreciation of the ideals for which the Institution is working, we shall at the same time ensure that he will become an active exponent of those ideals and will in himself be an active element in the corporate effort which the Institution is pledged to foster.

It will be of value to consider what practical form that corporate effort is to take, and further, the part which individual members can take in furthering the common object we have in view.

What is the Institution doing and what is it going to do to establish and maintain in India the professional standards for which it stands? In the first place we must ensure that Membership of the Institution connotes a high standard of qualifications judged both by educational and practical tests. We have a duty aid on us to see that these tests are such as will bear comparison with those applied by the parent Institutions and that no one is admitted as a member who does not satisfy those tests.

The proper training of the Engineer is one of the most controversial subjects which has ever agitated the minds of the technical world, and I am not going to be drawn into that controversy within the limits of this address. There are many kinds of Engineers and many ways of making an Engineer, and it is perfectly obvious that the means of education and training must be adapted to the human nature of the individual. Most of the schemes which have failed, have courted failure because they have endeavoured to force the various conformations of individual human being into one stereotyping mould. Let us agree that to produce a completely equipped Engineer, theory and practice must be inculcated in varying degrees to suit the individual. The danger in India, if I may speak from my own experience, is that the theoretical side of the process will be unduly stressed. This is partly because the Indian mind has a tendency to work on theories rather than practice, but mostly because Engineering training has always been considered to be a branch of Education and has been dealt withby Educationists. Our Engineering. Colleges have endeavoured to oust this heresy and have proceeded on well considered lines of administering both practical and theoretical work in varying proportions. But the best of our graduates from the best of our Engineering Colleges cannot hope to become Master-Engineers capable of handling practical problems without both practical training and practical experience. I do not wish to decry or minimise the advantages gained by Workshop practice and practical laboratory work in these Colleges. No amount of practical work under college conditions can produce the Master-Engineer, and it is for this reason that our Institution demands, like the great Institutions of Britain, a full measure of practical training and practical experience before admission to Associate Membership and a further period of practical execution of important works before promotion to Membership.

We have laid down our examination tests, and our method of election entails an investigation of the practical training and experience of the candidate by all Members of the Council, a body as is well known to you composed of some of the most distinguished Members of our profession throughout India. Our Examination tests have been designed so to give in the result a standard of admission similar to that of the Home Institutions and they are intended to be rigorously applied to all new entrants. In so far as we allow Engineering degrees taken from recognised colleges to exempt from part of the examination, we shall watch the standards adopted for giving these degrees, and we believe that the influence of the Institution on the work of the Engineering Colleges through the medium of this power to accord exemption to graduates will be a powerful factor in preserving high standards in the courses and examination tests adopted.

For Election, the Council also require evidence of satisfactory practical training and practical experience, and I can assert without hesitation that the Council proceeds neither by fear nor favour in deciding on suitability for admission so far as the records of practical training and work are concerned.

These are our practical means for ensuring a properly qualified Membership, but I should like to sound a note of warning. We have to recognise that there is no finality in a standard of this kind, and just as the Home Institutions periodically tighten up their educational tests, so we must look forward to an ever improving standard of education in the test for suitability for Membership. We must always be ready to apply a higher and higher standard as the years goon. We must avoid stereotyping our examination tests and be ready to progress forward with the progress which is daily being made in Engineering knowledge and experience. It is in fact essential to the carrying out of our ideals to arrange for progressive standardization in this matter of educational qualifications. In this branch of our activities we are looking for the active co-operation of our great Engineering Colleges whose Principals are, many of them, on our Education Committee.

It is, however, not enough that we should demand high qualifications for membership. If we are to fulfil our obligations we must watch and assist the means of attaining those qualifications both on the educational and on the practical side. If India is to have its own Engineering profession, India must have the means of educating and training Engineers, and the Institution must use its influence with those whose business it is to provide those means.

Some of the great Government Departments, notably the Railways, the Public Works Department and the Ordnance Department, have well established means of giving practical training to Engineers after their College training. In fact such training is part of the normal means adopted for recruitment.

So far as Civil Engineering is concerned there is little difficulty in India in providing the means of practical training, for there are always in progress construction works of sufficient magnitude and importance to form an unrivalled field for gaining experience and practical knowledge. On the mechanical side there is greater difficulty in providing practical training such as is comparable to the training obtainable in the manufacturing and industrial workshops of Europe and America. But there are these opportunities and both on the Railways and in the Ordnance Factories they are now being made use of to an ever-increasing extent. Great advances have been made in apprentice training in recent years, and speaking here in Calcutta it is not necessary for me to remind you of the improvements which have taken place in the outlook as regards this training and of the practical measures which have been adopted to put apprentice training on a sound footing.

While the Institution itself has in the past lent its influence to the establishment and improvement of schemes for practical training and will in the future continue to watch and assist the carrying out of these schemes, it is on the individual member that the success or otherwise of these schemes ultimately depends. A very great responsibility lies on every Engineer who is entrusted with the practical training of the student or apprentice. It is here that his opportunity of service to the Institution and the profession lies, and it is here that the greatest necessity exists for realisation of those ideals of which I have been speaking. In his relations with those under his charge he has an opportunity of passing on not only the knowledge and experience he has but gained something also of the spirit and outlook of the Engineers from whom he received his training.

To Engineers with Home training who are engaged in however small a degree in the shaping of the minds and outlook of the Engineers of the rising generation. the Institution makes an appeal which I believe will not tail in effect. The duty aud day I say the honour of handing on the traditions of our profession to those who are to succeed to the heritage of the profession in India is one which the Institution considers to be one of its primary functions and it is a work which must de largely left to the hands of the individual member. Whatever British Engineers have done in the past for India—and I do not believe that India will ever fail to recognise the greatness of the services rendered— there is no service which when judged by the verdict of history will stand higher than that of handing on in full measure the accumulated traditions of conduct and practice which belong to the Engineering profession of Britain and which the Institution is pledged to uphold and to transmit unchanged and inviolate.

Gentlemen, it is in the full belief of the capacity of the Institution to carry on this great work and of the determination of each individual member to do all in his power to assist the Institution in its task that we commence to-day another year's work. Let us look confidently forward to the next annual meeting with the certain hope that we shall have achieved further substantial advances along the road marked out for us.

Mr H Burkinshaw
President 1925-26

Presidential Address

Gentlemen ,—

The Council of this Institution as your representatives have elected me to be your President for the ensuing year, and I wish to express my thanks for the great honour which has been conferred upon me. The honour carries with it a measure of responsibility, and my distinguished predecessors have created a standard to which IT shall find it difficult to attain.

Our late President, Mr. C. D. M. Hindley, has been a pillar of strength since the earliest days of the Organising Committee, and it is much to be regretted that he is unable to continue as our President for another year. It is, however, a matter for congratulation that in spite of the many calls upon his services we are to continue to receive the benefit of his invaluable advice and assistance.

The aims and objects for which the Institution was founded are very clearly enumerated in the Memorandum of Association, and those public spirited, selfless Engineers who formed the Organising Committee must find some reward for their Jabours in the progress which the Institution has made towards the goal they had in view during the $4^1/_2$ years of its existence. The first eleven paragraphs of Clause 3 of the Memorandum of Association might with propriety he learned by heart and adopted as a creed by all Engineers whether Members of our Institution or not.

The Quarterly Bulletins and the Annual Report give information regarding the Activities of the Institution. It will be seen that these are very far-reaching and fulfil the purpose for which the

Institution exists.

The Local Associations, Bengal, Bombay, South India, and the United Provinces are well established and thriving entities. The formation of another Local Association has been mooted and the proposal is receiving the consideration of the Council.

The roll of Membership has increased from a total of 138 in 1920 to over eight hundred to-day, and there is every reason to believe that the number will rapidly increase until every qualified Engineer in India had been enrolled.

A very important decision was made in January of this year in connection with the reduction of the Entrance Fees. The whole question was under consideration for some considerable time, and it was ultimately proposed by the Council and approved by the Members at an Extraordinary General Meeting that the entrance fees should be reduced to Rs. 40 for Members and Rs. 32 for Associate Members. In making their recommendation the Council had before them the considered opinions of many Members and the opinions also of Gentlemen fully qualified to become Members but prevented from doing so by the comparatively heavy initial payments. I would remind Members that moneys accruing to the Institution from Entrance Fees are placed to capital account and are not appropriated to meet. revenue expenses. The Institution to-day is not in urgent need of capital nor is it likely to be so for many years to come. It is, however, essential for the well being of the Institution that qualified Engineers should be enabled to join it because then not only will the Institution be strengthened to deal with the purposes for which it exists but it will be strengthened financially and placed in a better position to meet expenditure chargeable to revenue. That the Council's recommendations as approved by the Member has been amply justified is proven by the fact that in the six weeks since the notification of the reduction in Entrance Fees 85 applications for admission to the Institution have been received as against 58 during the whole of the previous twelve months. I particularly wish to emphasise the fact that no alteration whatsoever has been made in the qualifications for admission to the Institution and none except fully qualified Engineers can ever hope to gain corporate Membership.

At no very distant date Membership of our Institution will be regarded throughout India as the hall-mark of the Engineer, and it is our bounden duty to devote earnest attention to the whole subject of the education and training of engineers in India. A number of Colleges and Technical Schools have come into existence, but until our Institution was founded there was no standard of comparison and the parents and guardians of aspiring engineers had none to guide them. Our rules of admission to the Institution together with the entrance examinations have provided a safe and sure standard, and because of this our responsibility is very great. India is at present in a transition stage, it is passing from an almost entirely agricultural country to an industrial country of importance. The growth of Industry and the development of the great mineral resources will necessitate extensions of the Railway systems, and all these will create a demand for trained Engineers. If the progress is to be sure it must be slow, and the rate at which the country can find employment for young engineers is directly proportional to the rate of industrial development. Earnest efforts must he made to ascertain and to record that rate. Whether this should be undertaken by Government, by the Colleges and Technical Schools, or by this Institution remains to be decided, but it is clearly the duty of this Institution to ensure that engineering students are not being turned out at a greater rate than that at which the engineering resources of the country can provide them with practical training for the completion of their education and later with permanent employment.

It is true and it is deplorable that in Europe and America and possibly also in India there are organisations which in exchange for money will grant high sounding educational degrees and titles. The victims are in certain cases innocent but in many cases the holders have purchased them deliberately with intent to deceive. This Institution will resolutely denounce all such organisations as occasion arises and will steadfastly refuse to recognise all such spurious evidence of education and training.

This year will mark the centenary of the birth of Railways. The Railways are themselves the product of the skill of the three principle branches of engineering—Civil, Mechanical, Electrical—and because this Institution is representative of them all our thoughts naturally turn to the progress which has been made in engineering in general. It is less than150 years since Watt proudly proclaimed :—"I have now gotten a lathe so true in its work that the bore of the cylinders is nowhere out of truth by greater than the thickness of a sixpence"—to-day it is common practice for tolerances of plus or minus half a thousandth part of an inch to be the working limits. The progress which has been made is indeed very great and it has been achieved not by the engineer alone but by the closest co-operation with the Scientist. We owe nearly all to the Physicist, the Chemist, and the Metallurgist, and we can make very little further progress until they give us some new law or material to work upon. It is perhaps not very greatly to our credit that we are still unable to utilise the Latent Heat of Steam in our prime movers and the problem does not appear to be near of solution. From which direction the next great advance will come it is impossible to predict, but whether it comes by the liberation of atomic force, a more direct conversion of heat to electricity, or by some channel not even yet indicated, we must be prepared to receive it, to master it, and to turn it to the useful service of humanity.

I have referred to the close co-operation between the Engineer and the Scientist, and I wish to indicate that there appears to be need for us to confer with the Biologist, more especially with the Bacteriologist with whom we have had few dealings in the past, except in the purification of water and the treatment of sewage. The decay and corrosion of building and other structural materials has been accepted by us as inevitable, we try to prevent it, we succeed in delaying it, and in somewhat vague terms we blame "chemical action."? It is known that many bacteria commonly present in soil und water are able to produce such powerful destructive agents as sulphuric, nitric, acetic, and carbonic acids. These, although formed in small quantities are yet able, by their action over long periods of time, to produce serious effects both upon metals and upon stone or cement.

Soil and water bacteria are also destructive to timber, more especially if imperfectly seasoned, and the by-products of bacterial action upon such lumber are frequently destructive to metals in contact with them. Further instances might be cited among which is the spontaneous combustion of coal. This is probably due to bacterial fermentation and requires investigation with a view to determining the possibility of preventing its occurence by methods based upon recognition of its bacterial origin. In dealing with the problem of the destruction of materials by weathering and decay, more exact information should be obtained as to the underlying causes and the conditions favourable to their action. Such information can only become available as the result of collaboration between the Engineer and the Bacteriologist, which should result in the concerting of measures suitable for the prevention of bacterial action. Our Institution should encourage research in this and kindred subjects, and I look forward to the time when we shall be in the position to undertake such work and to defray the cost from our own funds.

The Civil Engineer has been in India for centuries, the Mechanical Engineer for comparatively few years, and the Electrical Engineer has only just arrived, but the conditions pertaining in India at present are such that the period in which we live may be looked upon as the renascence period of Engineering in India. Our . Industries are growing and our Engineering works are cautiously expanding to meet the new needs. The onus for success rests upon the shoulders of Engineers and therefore upon the Members of this Institution, and if we ave to progress surely we must standardise. The whole idea of standardization is, broadly speaking, repugnant to the Engineer. His whole attitude of mind is against it due to his training and his inventive instinct, but the price he has paid for experience coupled with his sound fundamental common sense has led him to standardise wherever possible. This Institution is the organisation in India of the British Engineering Standards Association and of the International Electro-technical

Commission. These bodies lave established standards which have proven good, and they should be adopted by us whenever possible to effect economy and to improve efficiency. The closest and most. unselfish co-operation will he needed among Members to establish new standards in India from time to time as circumstances may prove to be expedient.

One of the most important objects of this Institution is to diffuse among its members information affecting Engineering and this can best be achieved by the reading of papers and by discussions upon them. The volumes of the Journal of the Institution contain records of which we are justly proud, and it must be our earnest endeavour to maintain that high standard. The Engineer in India has opportunities which are given to few. Very early in his career he is compelled to take responsibility and to utilise to the utmost the knowledge of the theory and practice of engineering acquired during his training. Although he may be compelled to specialise and to be expert in one particular branch yet throughout his career he must retain a catholic knowledge of engineering in general and keep abreast of the times. The amount of specialised invaluable knowledge in the possession of Members of this Institution is incalculable, and it is of vital importance to the welfare of Engineering in this country that that specialised knowledge should be accessible to the Engineering community. Until this Institution was founded there was no convenient and suitable channel along which information could flow and much knowledge remained as a personal possession or was buried in inaccessible files and office records. The work of the engineer is almost entirely constructive, and it is almost impossible for a description of it to be completely impersonal. In these circumstances, many Members, with a modesty unusual even among Engineers, lave expressed their reluctance to become anothers of papers because they fear the stigma of self-advertisement. It should not be necessary to re-assure them on this point, and it is greatly to be desired that they will commit their knowledge to paper, so that through the medium of this Institution it may be placed at the service of their fellows and be permanently recorded for the guidance of posterity.

The senior Institutions in England recognising that the Institution of Engineers (India) is representative of the great community of Engineers in this huge country conveyed to us, through the medium of the Kelvin Centenary Committee, an invitation to participate in the celebrations to commemorate fie hundredth anniversary of the birth of the great scientist, Lord Kelvin, This signal honour is one of which this Institution is very proud, and that it Was any great good fortune fo de nominated as your delegate on that occasion is a memory which T shall cherish together with that of the honour which von have conferred upon me to-day in electing me as your President.

Deewan Bahadur A V Ramalinga Aiyar

President, 1926

Presidential Address

GENTLEMEN

Allow me in the first place to express my grateful thanks to the members of the Institution of Engineers (India) for having elected me as their President for the year 1926-27. I greatly appreciate the high honour conferred thus on me by my fellow-members. lt is really gratifying to one's sense of pride, and in this case an excusable pride to have one's name coupled with that of a number of distinguished Engineers who before now have occupied the responsible and onerous position of President of the Institute of Engineers. I need hardly say that it shall be my best endeavour, with the assistance of my colleagues on the Council, to shoulder the heavy responsibility which the position of the President carries with it.

lt is gratifying to all of us that thanks to the unstinted endeavours of the previous Presidents of this Institution, who are one and all distinguished members of the engineering service, it has acquired a firm and strong basis in this country. Owing to the strong foundation thus laid, I am emboldened to accept this onerous duty as my predecessors have weathered the storm in the initial stages. To a certain extent it makes the position of the President a little more easy also.

Membership: During the past year the number of members has increased to nearly a thousand;' but still it is far from satisfactory. And for me, personally, it is painful to note that South India has contributed very few indeed towards the total strength. May I then take this opportunity of appealing to the engineers of this Province to get themselves enrolled in large numbers as members of this Institution? I am sure that my appeal to my brother members of the profession will not fall on deaf ears and when stock is taken of the membership next year, this Province I believe, would have contributed largely to the rolls thereof. Increase in membership of the Institution would strengthen it not only financially but in other ways also. With full membership, for instance, many more things will be possible than can now be thought of. More frequent issue of our journal, more papers and disquisitions, freer interchange of ideas will, to cite some obvious improvements, be easily acquired to our credit. Perhaps many of our profession are yet unaware of the recent reduction ill tile entrance fees made with, view to bring together all within the Institution, It must then be the first thing in our programme to enlarge our rolls.

Engineering in India, unlike other countries, has developed mainly on, the civil side, owing to the paucity of large industries aud industrial undertakings. The development of mechanical engineering and electrical engineering is yet to grow, The profession itself has been contributing largely to the departmental needs of the Government. There is yet to grow sufficient craft spit-it to make one feel proud of the profession. The need of the country for engineers trained in other branches than civil engineering is great indeed. The graduates that have been turned out from the various engineering institutions in this country have not, I regret to say, kept themselves up to date in their professional studies. They rest satisfied after securing a job and with that tile ambition of many a young man seems to end. There is little interest in him regarding the various improvement that arc taking place in recent years. He neither cares to bestow thought on the intricacies of the technique nor has he sufficient enthusiasm to subscribe tor and study the various professional journals on the subject. The remedy, the only remedy applicable to our case, is to be found in supplying the lack in this country of an independent profession for the Engineers. Just us the Lawyers and the Doctors have independent practice, so ought the Engineers to be allowed to entertain private practice. And not only should such private practice be allowed to countenanced, it must he greatly encouraged, I may here refer to one mode hy which such encouragement might be afforded, Within the jurisdiction of every Municipality or Local Board, and with the assent obtained of such body, are several building constructions and improvements made. Should it be made obligatory that every plan submitted for approval and sanction, must proceed from or bear evidence of having been scrutinised by an approved Engineer (a list of registered Engineers being maintained for the purpose as there is in the case of the other professions of Law and Medicine) the profession would not only he very much encouraged in taking part in active life, hut the public also will be benefited hy seem-ing stable, strong and handsome buildings for the money spent by them.

India is mainly an agricultural country, and as such the attention of the engineers has to a large extent been centred upon irrigation projects. We are almost coming to the end of expanding irrigation with ordinary anicuts, It will not be out of place here to mention the recent additions to the irrigation projects of this country. The Kannambady project has almost reached its final stage. It is indeed a matter of pride to us that this project bas been designed, executed and brought to a finish mainly through the agency of Indian Engineers. There are still greater laurels awaiting the craft in a larger number of projects which have yet to be completed. There is the Grand Sutlej Valley Project which promises to transform the desert land of Bikaner into smiling wheat fields. The Lloyd Barrage at Sukkur will greatly contribute to the increased growth of cotton and wheat. In our Presidency the Mettur Project is expected to supply water to the thirsty lands of Tanjore and Trichinopoly. One other point I shall mention in passing and that is that in the Kannambady Project no machinery has been used either for lifting or for conveying materials to the work spot. Such is not to be the case in the execution of the newly designed projects mentioned above. In the Sukkur Barrage Scheme a larger amount of machinery is being used for excavation purposes. In the Mettur project also machinery is going to play a large part in the excavation of canals and in the construction of the dams and culverts needed to carry out the project. There are yet some projects in our Presidency which have not reached the stage when they can be started for execution. I refer to the Thungu Bhadhra Project and the Bhavani

Reservoir Project. I must here mention with a certain amount of pain that our engineers here have been very chary of doing tunnel work for irrigation purposes, though there are a few instances of such work being undertaken in the Periyar scheme and the Swat River Canal in the North-western Frontier Province. The proposals for a tunnel about 2 miles long in the Coimbatore Water-supply scheme has not been taken up though it was intended for the town supply and for the diversion of some irrigation water from one valley to another. Having exhausted the irrigation schemes with ordinary anicuts it must be the duty of the engineers to design large storage reservoirs tel irrigation purposes as is being done largely in the Bombay Presidency and in Hyderabad. In heavy monsoon areas large quantities of water run to waste which can by careful conservation and properly constructed reservoirs contribute to the economic prosperity of this country.

The Government of this Province have recently undertaken and completed a Hydro-Electric Survey. They have on hand projects for the generation of electric power by Hydro-electric schemes. I need only mention the Pycara scheme which is the largest among them. Great things are expected of these hydro-electric schemes when they are working in full swing. They will contribute to the economic prosperity of the country in a measure unprecedented and marvellous. Not only that the very foundations of society, the lives of the various classes of people will undergo a decided change in the direction- of progress. Many cottage industries will easily spring into existence, when the supply of electric energy becomes possible to every house in the Presidency. Even the great and perplexing problem of unemployment will find a solution thereafter with the growth, expansion and development of minor indoor industries, while labour will *suo moto* be elevated to that dignity and rank with which it i vested in the west and which it ought to find in India, as well. And with the large field for industrial and economical advancement thus opened, a large number of people will find work ill national aud healthy pursuits and national improvement is bound to follow. Will it then be too much to say that the Hon'ble Sir C. P. Ramaswamy Iyer has, out of that indefatigable energy, acute intellect and keen foresight characteristic of him, conferred on the people of this country, a boon whose worth would be inestimable.

It is a deplorable fact that, owing to the exploitation of this country by foreign manufacturers, there has been a lack of a healthy standard for Machinery needed by the various industries that are at present holding the field. Without fear of contradiction, it has to be acknowledged that 1he primary need of industrial advancement is the standardisation of machinery needed for the various trades. This institution can well try to apply itself to, tackle this important problem and fix satisfactory standards for the need of the existing industries, as well as for those that are likely to be started.

This of course, will need the provision of large laboratories and workshops for research and test. There are already available large laboratories at Calcutta, Bombay, Bangalore, Jamshedpur and other places. But more such institutions are necessary to (any out efficiently the research work needed for the industrial expansion of the country.

The members of our profession cannot achieve much by keeping themselves aloof from those of other scientific professions. The application of modern science in daily life necessitates team work; and as such it is not possible for anyone branch of scientific knowledge to achieve results wort hy of note without the co-operation of the members of other professions. In this connexion may I draw your attention to the recent address of Mr. Howard, President of the Indian Scientific Association, delivered at Bombay, where he has clearly emphasized the above fact. The success of the Panama Canal Zone for human habitation has been possible, mainly on account of the co-operution of the Engineers with the members of the medical profession.

Members and public institutions may be requested to found special prizes for special contributions regarding various trades and this will facilitate the collection of very valuable information by y of articles for our Journal. It will also make it easy for our members to obtain anthoritative opinions on questions of varying interest from the contributions of eminent engineers throughout India. One most important object of this institution is the diffusion among its members of information regarding the various branches of engineering. This purpose can best be achieved by the contribution of papers dealing with the various aspects of the profession.

Before dosing, let me once more appeal to my fellow engineers who have not yet joined the Institution to enrol themselves as members. For if is my highest ambition that this Institution should represent the life of the Indian Engineer in all its aspects and thus assume that importance that it is entitled to as the core of the Engineering Department an integral part of the profession considered *en masse*. I believe it will not be in vain to wish for it that status which sister institutions enjoy in the west, of having their membership alone considered a hall mark of capacity or proficiency *ipso facto* and even getting entrusted with the training of young men to the profession and the conduct of examinations for this purpose.

With that life for the Institution, I devoutly appeal to yon, Gentlemen, to co-operate to realise our ideals in every conceivable way and the *summum bonnm* of our happiness shall then be in our attempts therefor. Our idea s and ideals are ill themselves their inexhaustible rewards.

Mr W H Neilson

O.B.E, V.D.

President 1926-27

Presidential Address

The position which I find myself in to-day is a consummation of my hopes and ambitions. I deeply appreciate the honour you have shown me in electing me President for the coming year. I may say honestly that, whatever my hopes may have been, I never expected to reach the highest place in the Institution, and with my necessarily incomplete and inaccurate knowledge of my shortcomings, I feel unworthy to tread in the steps of those who have gone before me. You may be certain, however, that I shall do what in me lies to help forward the Institution, and keep its interest to the forefront on all possible occasions.

When the proposal to form this Institution was first put forward, I realised that it would be a most effective means to help Engineers and Engineering in India. I gladly joined the new-founded Society and am proud of the fact that I am a founder member. The Institution, since its inception, has achieved a great deal, and with its large and increasing membership, carries great weight in Engineering matters. It-has brought together, on a common ground, the men engaged in our profession who are scattered over the vast Continent of India. It has enabled them to exchange ideas, and, what is even better, to get to know each other personally. It bas bound us together with a common tie and has undoubtedly raised the status of Engineers in India. We have been able to achieve the latter most important point by insisting on a high standard for election as Corporate member and have further increased our standard by inaugurating a strict examination test when a candidate does not possess sufficient qualifications.

It is said, with the merit of truth, that one receives from an organization much in proportion as one gives to that organization, and I would impress upon members, more particularly our Indian members, for whom the Institution was primarily founded, the necessity, and advantage, of submitting papers, on subjects with which they are most conversant; either to the Local Associations or the parent body. It is not necessary that such papers should deal entirely with original research, Descriptions of works of all kinds which have been carried out, or are in process of construction, are most valuable, and in many cases impart information to other Engineers which is not available in text-books. The particular difficulties with which one has met, and the method of overcoming them, are not only illuminative but in most cases are highly instructive. One feature which is noticeably absent from nearly all Societies' papers, are descriptions of failures. Naturally one is averse to proclaim one's shortcomings, but it is a fact that more can be learnt from one failure than from a hundred successes, A certain amount of sacrifice from an individual for the benefit of the majority is called for. I am not referring to failures due to faulty construction or design but to those which occur owing to unforeseen or incalculable forces. A good example of what T have in mind is contained in a paper recently submitted by a member on the new entrance fo the Kidderpore Docks, where a vivid description is given of the movement of the dock walls in the old docks, shortly after completion. T have no doubt but that the design of the new King George's Dock 'at Calcutta has been influenced by this extraordinary failure, and the magnificent work, now being carried out under the supervision of Mr. McGlashan, in the neighbourhood of the old docks. will surely be carried to a successful conclusion.

Engineers in these days are specialists aud perhaps the Port Engineer is of the most highly specialised: products of modern days. The forces he is up against, the tidal currents he has fo study, the regime of harbours and Ports which when disturbed cause unenviable anxiety, the dredging problems, the magnitude and depth of the works—all combine to make his position a highly respectable and onerous one. As an Engineer intimately connected with Port and Dock work for over twenty-six years, Members will perhaps pardon me if I turn to this subject which concerns me nearly and in fact concerns India very largely. I refer, in particular, to the Ports of India. Through these ports flow the immense volumes of import and export trade which make up the life of a nation. We have to accommodate in our Ports the ships trading to the British Empire and foreign countries as well as the coastal trade. The gross registered tonnage of shipping entering and leaving Indian ports in 1925-26 was some 65 million tons and the value of the maritime trade approximated Rs. 900 crores. To accommodate this tonnage and give facilities for handling and storing ships' cargoes, as well as erecting and maintaining various entrepots and depots for all sorts and conditions of trade, the Ports of India have spent to date some Rs. 65 crores.

Ports, like other large institutions such as Railways, Municipalities etc., have to keep up to date and it is axiomatic that any Port which does not do so, must gradually atrophy and become relegated to the back-ground. No Port can afford to stand still, and it is the object of these few remarks to see how we in India are meeting the situation and whether we have proved worthy of our trust.

Amongst the numerous duties which a Port is called upon to do, the chief, and principal one is to provide sufficient and ample accommodation for the ships visiting the Port. It is not difficult or expensive to provide for two dimensions of a vessel, namely, the width and length, but the provision of sufficient depth to keep a vessel afloat at all stages of the tide and to allow her to enter and leave the Port. whenever she requires to do so, is a problem which has entailed the expenditure of vast sums of money, and, in the case of some Ports, has placed a limit on the size of vessel which can trade with that particular Port.

We are governed, so far as the draft of boats is concerned, by the available depth of the Suez Canal, and as this depth has been increased from time to time, so Ports have to follow suit. The authorised successive increases in allowable drafts of vessels traversing the canal have been as follows :—

1890	25′ 7″
1902	26′34″
1906	27′
1908	28′
1914	29′
1915	30′
1922	31′
1925	32′

The new scheme for improvement drawn up in 1921, provides for a depth of 13 metres or 42’8" and for the transit of ships measuring 45,000 tons gross, length 265 metres, width 29 metres, draft 10.67 metres or 35 ft. The depth of water is made up as follows :—

Draft of ship	35′	useful depth 39′5″
Margin between draft of ship and useful depth of canal ...	4′5″	
Possible thickness of sand on canal bottom	3′ 3″	
	42′ 8″	

This will allow a draft of 36 ft. if needed.

The increase in depth has been demanded by the ever increasing size of vessels and the following table shows how advantage has been taken of the accommodation provided :—

Number of passages through the canal according to draft and size of vessel.

Draft	1910	1920	1925
Between 26′ 38″ & 27	174	230	
27 & 28	107	129	
28 & 29	—	53	172
29 & 30	—	10	44
over 30	—	—	24
Gross tonnage			
Suez Canal Measurement	1913		
6,000 to 8,000	1238	1216	2178
8,001 to 10,000	334	448	803
10,001 to 12,000	69	96	287
12,001 to 16,000	66	64	101
above 16,000	2	17	70

The Suez Canal has kept well ahead of requirements and there are now only 8 ships afloat which could not pass through at the present authorised draft. These vessels however are high speed passenger boats on the North Atlantic run and it can therefore be said that the Canal can take any vessel afloat on the Eastern Trade. After the completion of the 1921 programme of works, the Canal will be in as good a position to take large vessels as the Panama Canal. The total depth of water in this latter canal is 40 ft. and allowing only the small margin of 3 ft. under the keel, the permissible draft would be 37′ but as this is in fresh water the comparable depth in salt water would be about 36 ft.

It is to be seen now how the Indian Ports have met this increase in size and draft of vessels. The larger Ports keep before them the recommendation of the Dominions Royal Commission which stated in their final Report that certain ports on various trade routes should be deepened so that accommodation may be provided throughout these routes for vessels of the following drafts :—

39 ft. on the route from the United Kingdom via the Suez Canal to the East and Australia. Statement A shows the increase in size and draft of vessels tracing to Indian Ports.

The greatest draft of any vessel entering Indian Ports (excluding the 8. 8. “City of Exeter”? referred to later) has so far been 33 ft., namely, the “H. T. Caronia” whieh sailed from Bombay. on the 8rd February 1918.

It is now proposed to deal with the various Ports and tostate their present and proposed arrangements.

CALCUTTA

Approaches

The Port is situated on the River Hooghly and is 82 miles distant from its mouth. Navigation is difficult at the month of the river, the channels wind through numerous sand-banks and the best route has to be chosen through ever-varying depths along the line connecting the deep places and over the shallows. These latter vary constantly in depth but when one place gets too shallow, usually another opens out and gives deeper water, Last year the Middleton Bar was the governing bar for 329 days during the year, giving between 15′—6′′ and 16′—9′′. Further up ate two shoals, namely, the Balari Bar near the head of the estuary, and the Gabtola Bar. Above these, where the Rupnarain River enters the Hooghly, a seasonal bar is developed. Higher up, there is the famous “James and Mary" reach, caused by the entrance of the Damodar River, where the channel is divided into the Eastern gut and Western gut. Above this, the river has the usual characteristics of Indian rivers in the plains. It wanders about, with the deep channel hugging the concave side, forming shoals at the crossing points. The crossings which give the most trouble are the Moyapur and Royapur. To ensure the best navigational line, a constant system of surveys is kept up together with a complete arrangement of semaphores and river marks. Improvements have been effected on the bars in the upper reaches. The suction dredgers “Sandpiper”, “Balari” and “Gunga” work on the Eastern gut and Moyapur Bar where in the case of the former the depths have been increased from 3 to 4 ft. more than was available in the worst months up to 1906 and in the latter an increase of nearly 8 ft. bas been obtained. The dredgers also work on the shoal places nearer Calcutta namely Panchpara, Pir Serang, and Sankral. The effect of the work undertaken, in the shape of river surveys and dredging has been to increase the allowable draft of vessels navigating the river from 25′—2′′ in 1880 to 29′—10′′ in 1920. Vessels drawing over 30 ft. can navigate the river by taking advantage of the tides.

Port proper and Docks

In the Port proper there is plenty of water, the 4 fathom contour being continuous on both sides with the exception of a small patch at the Hastings shoal. Low Spring tides, however, seldom fall below 2 ft above datum, so this shoal is not a serious one. The depth at the double moorings varies between 30 and 51 feet and at the Strand Road jetties there is an average of 32′—6′′ below datum. At the new Riverside jetties, the depth is not less than –34.00 ft. so although these jetties are tidal, there is ample water.

The Kidderpore Docks are entered directly from the River by means of a 60 ft. lock and a single 80 ft. gate. The sill level of so with a mean neaps rise of 12 ft, there is 29 ft and on the springs 34 ft. of water, allowing vessels of 28 ft draft and upwards to enter. Both the Tidal Basin and Docks Nos. 1 and 2 are kept up to a level of + 21.50, and the bottom of the Docks being –12.00, there is 33$^1/_2$ ft. of water in the Docks. 'The designed water level was + 16.00 but this was raised owing to the failure of the walls shortly after construction.

The 80 ft. entrance however has never been much used chiefly on account of the high level of the water in the Docks and also because it is at right angles to the river. Consequently all the work fell on the 60 ft. lock. This lock is only 400 ft. long between gates but with the use of caissons at both ends vessels of 510 ft. in length can use it. With the increasing size in vessels and as the lock has been used without cessation, the necessity of building a larger lock arose, and this is now in course of construction. The new lock, which is close up against the old one, has a width of 80 ft. and a length between gates of 580 ft. By means of caissons another 80 ft. can be added to the length. The level of the outer sill is-19.00 and of the inner sill – 17.00.

In addition to this, a new Dock system, which will eventually contain over 30 berths, has designed und work commenced on five berths and two entrances. The situation of this Dock is about a mile below the Kidderpore Docks. The entrances are duplicated, one of them being designed as a tandem Dry Dock. The entrance lock, closed by sliding caissons, has a length of 700 ft. and a width of 90 ft. with the inner sill at –21.00 and the outer sill at –22.00. The minimum drafts in the lock are 31 ft. at High Water and 243 ft. at Low Water. The tandem dry dock has a width of 80 ft. and a total length between centres of caissons of 1,216 ft. divided into two clear lengths of 590 ft. and 575 ft., the inner and outer sill levels being both at –21:00. The water in the Dock will be at kept + 15-00.

BOMBAY.

Port Approaches.

The distance from the Pilot Station to the anchoring ground is some 4$^1/_2$ miles and the depth of the channel varies from 40 ft. to 33 ft. below L.O. S. T. The anchoring ground for large vessels has a depth of 40 ft. and these vessels can swing at their anchors in this area.

Port Proper and Docks.

The approach channel to the older Docks has a depth of 17 ft. and to the Alexandra Dock 24 ft. This latter is now being dredged to –28.00. The datum is that of lowest ordinary spring tides but as L. W. O. S. T. is 2 ft. 3 ins. higher, this additional depth can be secured on most days of the year. The Ballard Pier, at which the nail, steamers berth, has a depth alongside of 28 ft. and is now being deepened to 32 ft. below L. O. S. T.

The Prince's and Victoria Docks, opened respectively in 1880 and 1888, have single gate entrances and are consequently half tide docks. The sill level of Prince's Dock is – 14.00 and that of Victoria Dock, – 16.00. The water level of both Docks is kept at about + 8:00 and the bottom levels being – 17:00 and – 19.00, there is an available depth in| Prince's Dock of 25 ft. and in the Victoria Dock 27 ft. The length of vessels having outgrown the original designed length of berth, the number of berths in Prince's Dock is now 9 as against 14 in 1883 and in the Victoria Dock the number has been reduced from 16 to 13. This shows the advantage of straight line berths.

The Alexandra Dock opened in 1913, has an entrance lock 750 ft long between gates and 100 ft. wide. The length can be increased by the use of caissons. The level of the outer sill is — 27.00 and the inner sill –23.00. The level of the bottom of the Dock is –25.00, and with the water in the Dock at an average level +11.00, there is available 34 ft. of water over the inner sill. On High Water Springs this can be increased to 37 ft.

The Hughes Dry Dock, 1,000 ft. long, is entered from the Alexandra Dock and has a width of 100 ft. at the entrance and a sill level of – 22.00. The Dock therefore is capable of ordinarily taking vessels drawing 32 ft., but ships of deeper draft can be docked when required. In June 1917, the *City of Exeter*, having struck a mine outside the Harbour, was drydocked with a draft forward of 34 ft. 4 ins. and aft 22 ft. 5 ins.

At the north of the Harbour is placed a bulk oil pier for kerosene and petrol and has an approach channel dredged to – 20.00 with –30.00 at the turning and swinging basin and alongside the Pier, which is in tidal waters.

KARACHI.

Port Approaches.

Karachi is a tidal Port with an approach channel about 2 miles long to the jetties and about a cable in breadth, The depth of this channel is at present about 25 feet below L.W.O.S.T., but arrangements are being made to deepen this to –28.00 as well as the channel abreast the jetties. The mouth of the Harbour, which formerly had a bar with only 8 ft. of water, is controlled by a training groyne on the east side and a breakwater on the west side which effectively maintain a permanent depth at the entrance of 27 ft.

The mean range of greatest ordinary spring tides is 9 ft. 3 ins., but as there are several minus tides, varying from a few inches to a foot, during the year, the available depths are somewhat diminished.

Port Proper.

The depth of water at jetties, some of them built many years ago, varies from 27 to 29 ft. at L.W.O.S.T. The west wharf now under construction is of monolith design and these berths will be dredged to –34.00. This depth together with the proposed increased depths in the channel and entrances will allow a 33 ft. draft vessel to enter at H.W.O.N.T., with 5 ft. under the keel at the entrance, 2 ft. under the keel in the channel and 1 ft. when lying alongside.

Further proposals are in hand for re-building the jetties on the eastern side to give a greater depth at Low Water.

The Warbour is really a large lagoon capable of practically unlimited expansion. The waters from the Chinna Creek, an inland basin, flush the ships' channel every tide and help to keep this to the depths required. The jetties and west wharf being built in straight lines can adapt themselves without alteration to the longer vessels visiting the Port and the width between these wharves being 1,200 ft., there is ample room to swing a vessel preparatory to berthing or leaving the Port.

RANGOON.

Port Approaches.

Rangoon, the Port of Burmah, handles the whole of the import trade and a very large proportion of the export trade. The Port is a tidal one, the mean range of greatest ordinary springs being 16.4 ft. Indian Spring Low water mark is + 1.56 ft. There are a few minus tides in the dry weather varying to 7 inches. The distance from the Pilot Station to Elephant Point at the entrance of the Rangoon River is about 18 miles and from there to Rangoon 22 miles. The Rangoon River is the name given to the lower reaches of the Hlaing River which is one of the mouths of the Irrawaddy, and the approach to the river entrance is divided by the Eastern Sands. The Eastern channel is at present not used but shows signs of opening out, while the west channel, at present navigated, shows from recent surveys that the least water on the bar remains at 15 ft. From there is good water all the way up to Liffey Island reach where there is a 20 ft. shoal. Liffey Island is the crest of a shoal known as' the Hastings which is situated at the confluence of the Rangoon and Pegu Rivers and constitutes the principal obstruction to navigation. The Hastings carries from 5 ft. to 12 ft. according to season, but a dredged channel round its edge along the left bank of the river, known as the Monkey Point channel, is maintained between 15 and 16 ft. In 1866 the width of the Rangoon river between Monkey Point and King's Bank was 6,950 ft., but owing to erosion at King's Bank the width in 1922 had increased to 9,650 ft. In 1922 the Commissioners sanctioned a scheme for the erection of a brushwood and stone groyne 6,000 ft. in length at the King's Bank. This groyne is being erected on approximately the line of the 1866 foreshore and the idea is to hold the Rangoon River to a definite width of 6,950 ft. and protect the King's Bank foreshore and also to improve the water in the Monkey Point channel which will equalise the navigable depth on the inner and outer Bars.

Port Proper.

The Port proper comprises the east and west reach of the Rangoon River just above that River's confluence with the Pegu River and extends for about two miles and is from $^1/_4$ mile to $^1/_2$ mile in width. An extensive training wall at the west limit of the Port where the river takes a sharp turn north has saved the left Bank of the river within the Port from silting and has effectively prevented or reduced erosion on the right side. Along the Rangoon side are a number of pile jetties and pontoon landing stages, the length of wharves being 2,822 ft. with 25 ft. depth alongside. These wharves will be extended to form a continuous line of 4,000 ft. including a berth to accommodate vessels drawing 30 ft. There are a number of fixed and swinging moorings both in the Harbour, the Pegu River, at Kemmendine and below Hastings, with 45 ft. to

25 ft. at low water. These are being increased in number.

Nearly all loading is done in the stream and very deep ships have to go below Hastings to complete before departure or lighten before going up to Rangoon. Oil tankers fill up at Syriam, below Hastings. The Port Commissioners have purchased and leased a large area of land with a frontage on the Pegu River with a view to building enclosed docks should it be found necessary to do so. The position chosen will avoid the necessity for vessels having to navigate the Monkey Point channel and will thereby improve the turn-round of deep draft vessels.

MADRAS

Madras, formerly an open roadstead, has now a well sheltered harbour of 200 acres. Alterations have taken place from time to time in the Harbour, the entrance has been moved from the East to the North and deep water quays have been constructed in place of open piers and fixed moorings. Situated on the Bay of Bengal, the range of spring is small, namely 3.5 ft.; mean L. W. O. S. T. being 1.76 ft. above Datum of soundings. The width at entrance is 400 ft. with 34 ft. depth at low water. The new west quay has depths of $27^1/_2$ to $31^3/_4$ ft. and it is proposed to deepen quays Nos. 2 and 3 to $33^3/_4$ ft. The south quay will also be deepened from $31^3/_4$ ft. to $33^3/_4$ ft. and the north quay under construction will have a depth alongside of $33^3/_4$ ft. The east and outer quays are at –27.76 and the petrol jetty (outside the Harbour) will take down to $32^3/_4$ ft. from $32^1/_4$ft. The buoy moorings at present between 30 to $32^1/_2$ft. will all be dredged to $33^3/_4$.

VIZAGAPATAM

Port Approaches

This is a port in the making and will be the only Railway controlled port in India. The natural features are somewhat akin to those of Karachi. The Port is a tidal one, the greatest range of ordinary spring tides being 5.1 ft. Datum is Indian Spring Low Water mark, but there are several minus tides during the dry weather varying from a few inches to a foot. The highest recorded High Water was 6.70 ft. The distance from the 5 fathom contour in the Bay to the Harbour is under $1^1/_2$ miles and the consideration of the construction of the breakwaters is deferred until it can be decided whether it is less costly to keep the channel open by maintenance dredging rather than construct such breakwaters. There is little lateral movement of sand at the entrance and tidal currents are practically normal to the shore. The channel in the creek has rock to the south. side and north side will be protected with stone pitching. Both channel and Harbour proper are to be dredged to –30.00 and the dredgings used for reclamation.

Harbour Proper.

The complete scheme for the Harbour consists of a series of parallel jetties in echelon varying from 3,781 ft. long to 2,150 ft. and width from 650 ft. to 550 ft. The distance between jetties will be 500 ft. to 600 ft. The first section of works includes a wharf wall 1,800 ft. long berthing three ships. Moorings for two vessels will be laid down and an oil depot on the south side of the Harbour with a mooring for one ship will be constructed as well as a wharf for manganese ore. The channel opposite the oil tanks will be taken down to –20.00 and a tidal scour channel joining up the tidal scour basins to the Harbour will be taken out to –1.00.

CHITTAGONG.

Port Approaches.

This port affords a good example of the difficulty of dealing with Indian rivers. Above Sadar Ghat, the river has sometimes cut into the bank a distance of 400 feet in one year, making a channel 40 feet deep at low water where there formerly were rice fields. It has also, in one freshet, short-circuited a long bend and altered the position of the main channel by nearly half a mile. The effect of such heavy erosion is felt on the Inner Bar which silts up about 4 feet in a few days. Below Sadar Ghat the concave bank has been revetted with stone on the "Bell Bund" principle.

The approach to the jetties is 9 miles long with an Outer and Inner Bar with 10 to 12 feet of water at low tide and a sharp turn at the Gupta Crossing which carries about 14 ft. Between the jetties and Sadar Ghat, near which the coasting vessels swing, is the Ring Bar with 15 feet, partially dredged through to 21 ft.

Dredging is carried on continuously on the Inner and Outer Bars, in order to keep these Bars open as much as possible.

Port Proper.

The Port is a tidal one, springs rising to 13 feet in the dry weather and 16 feet in the rains. Minus tides fall to as much as 18 inches below datum of soundings, the day tides being higher between March and September, and lower between September and March.

There are four jetties with a depth alongside of 24 ft. as well as double and single moorings with depths of 24 to 25 ft. and an oil berth further down the river with 28 ft.

The Port Authorities are about to undertake a comprehensive scheme for the improvement of the entrance to the Port. The mouth of the river is bifurcated and the flood comes up the Juldia channel when the last of the ebb is traversing the Patunga channel. The latter is the one used by vessels entering and leaving the Port. The proposal is to close the Juldia channel at its upper end thereby throwing the ebb and flood streams in one channel. This work, together with dredging the stiff plastic clay, of which the Inner Bar is composed below –14.00, should have the effect of doing away with both the Inner and Outer Bar. In addition, further revetting will be done on the Patunga side so as to hold the bank where the main stream impinges on it.

OKHA.

This Port is one of the latest to be developed along conventional lines.

Situated in the Gulf of Cutch behind Dwarka on the Arabian Sea it is almost land-locked, the entrance being protected by Samiani Island and numerous sand banks. There are two approach channels to the East and West of Samiani Island with a depth of 18 and 22 ft. at L. W. The Port itself is tidal, the mean range of greatest ordinary springs being 12.4 ft. Datum of soundings is M. L. W. O. S. T., there being a few minus tides of two or three inches.

One pier has been built 400 ft. long connected with the main land by a viaduct 500 ft. long. It can berth two vessel one on either side.

The depth of water alongside the Pier is 30 ft. at low tide and vessels can anchor off the Pier in 24 ft. of water.

COCHIN.

Developments are now taking place for the purpose of providing Cochin with a first class Harbour. The Harbour will be a tidal one, the mean range of greatest ordinary springs being 3.2 ft. Datum of soundings is—M. L. W. O. S. T. and the Highest High Water recorded is +4.30. There are a few minus tides during the year, but these are of no importance.

The first stage of the work which is now being carried out is the dredging of the Harbour and its approaches to allow vessels drawing 26 ft. to moor in the stream. The area near by is being reclaimed from the dredging. The foreshore on the north side of the Harbour at Vypeen has been protected and portion of the reclamation wall completed. The channel through the outer Bar has been dredged and in order to keep the ebb and flow of tidal water in the required direction, a channel in the back waters, 6,000 ft. by 100 ft. wide and 18 feet deep, has been made.

The new channel, near the crest of the Bar, will be 800 ft. wide and the depth 35 ft. at low water. The whole scheme contemplates the provision of wharves or jetties with complete modern equipment and the extension of railways to serve the Port.

TUTICORIN.

Similar developments to those taking place at Cochin are being carried out at Tuticorin. The tide levels are the same as those at Cochin with the exception that there are no minus tides, low water springs being +0.30. There are certain peculiar tides at the time of the Moon's quarters when there is no true high or low water, with practically slack water during the tide.

It is proposed to form a turning basin for vessels drawing up to 26 ft. and later on to construct wharves or jetties with mechanical equipment and railway service. At present dredging and rock breaking is being carried out and a narrow land-locked canal with a turning basin of 1,000 ft. square is being made.

The hard material will be dumped on the site of the breakwaters which take the shape of two converging arms for the protection of the approach channel.

A protection embankment to the south-west of the Harbour will be thrown up to prevent blown sand entering the Harbour.

MORMUGAO.

The Port of Mormugao is in Portuguese territory about 225 miles south of Bombay and was acquired by the Portuguese in 1543. It is directly on the Arabian Sea and the Harbour is protected by a breakwater 1,700 ft. long and a mole, 900 ft. long, runs from the end of it. The accommodation is tidal, spring tides being about 6 ft. The depth at the entrance is 27 ft. at low water wnd the area of the anchorage 99 acres, with a depth from 23 to 26 ft. A drag suction hopper dredger is used to remove the siltation which occurs during the monsoon months. The quay wall is 2,000 ft. long with 5 berths. At the first three there is a depth alongside of 24 ft. and 30 ft. at the others. The new extension is designed for 30 ft. at low water.

From the above, necessarily brief, resumé, it will be seen what the Ports of India (the Port of Colombo is not considered in this review) are doing to meet the situation caused by the increase if size and draft of modern vessels. All the major ports in the course of a few years will be well ahead of the times. River Ports such as Calcutta and Rangoon are handicapped by long approaches and difficult navigation and the expenditure to improve these approaches must necessarily be heavy.

India with its vast coast line of over 4,500 miles has few major Ports and the addition of a new one at Vizagapatam will naturally tend to help the maritime trade and afford another outlet for the great. export trade of India. The minor and coast ports are also taking themselves seriously and are improving their harbours so as to get their share of the trade.

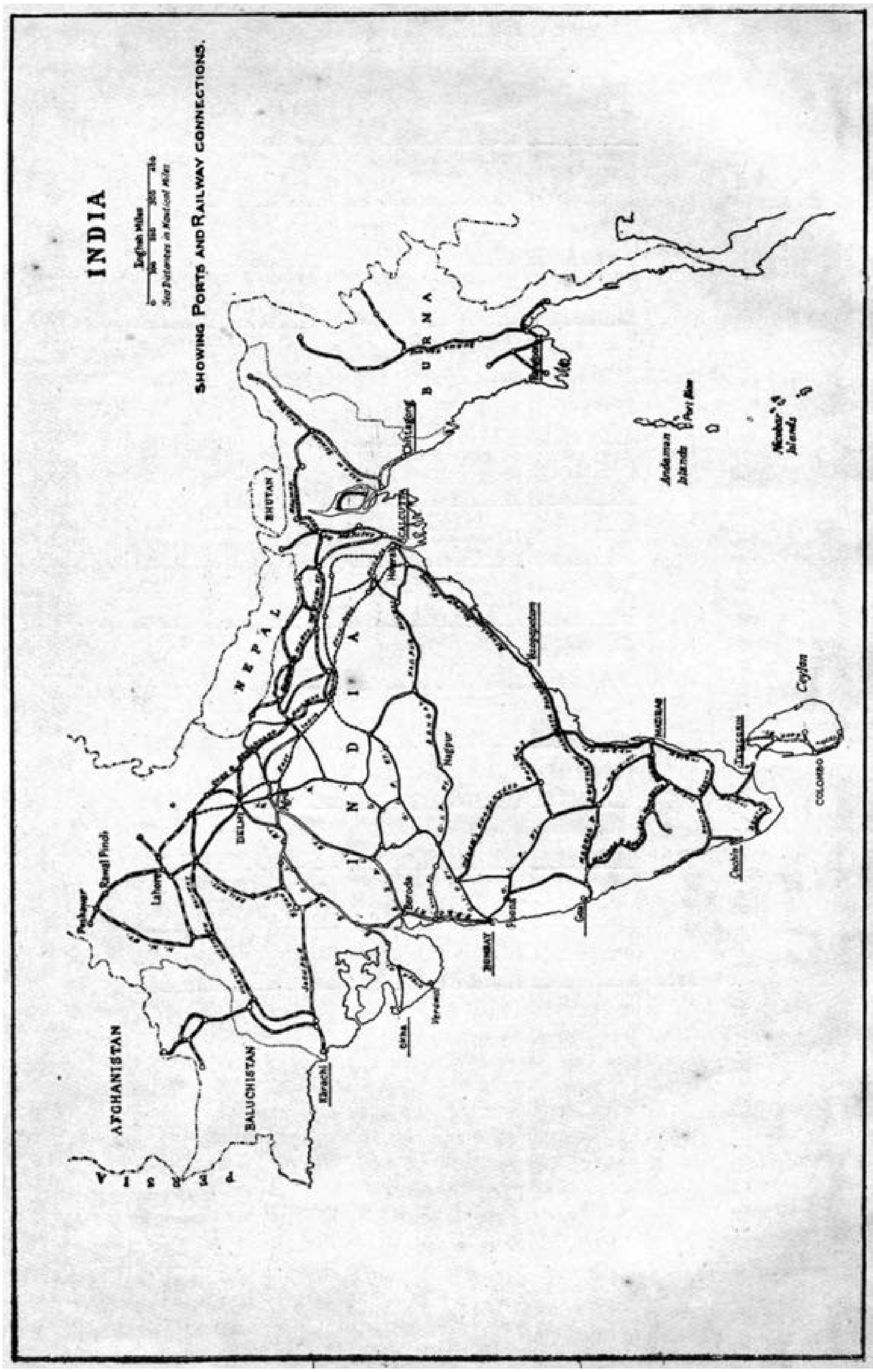
There are other matters also which must be considered in connection with facilities offered for large vessels but space precludes. Two items which are important may be mentioned, namely, bunkering facilities for motor vessels and those using liquid fuel and also Dry Docks. Most of the major ports can now bunker such vessels at any berth they are likely to go to and further extensions of pipe lines and connections are in hand. As regards Dry Docks India is rather poorly supplied. Bombay has a 1,000 ft. graving Dock and Calcutta is new completing an even larger dock but beyond these two there are no others which can take the big vessel. This situation will undoubtedly be remedied in the course of the next decade.

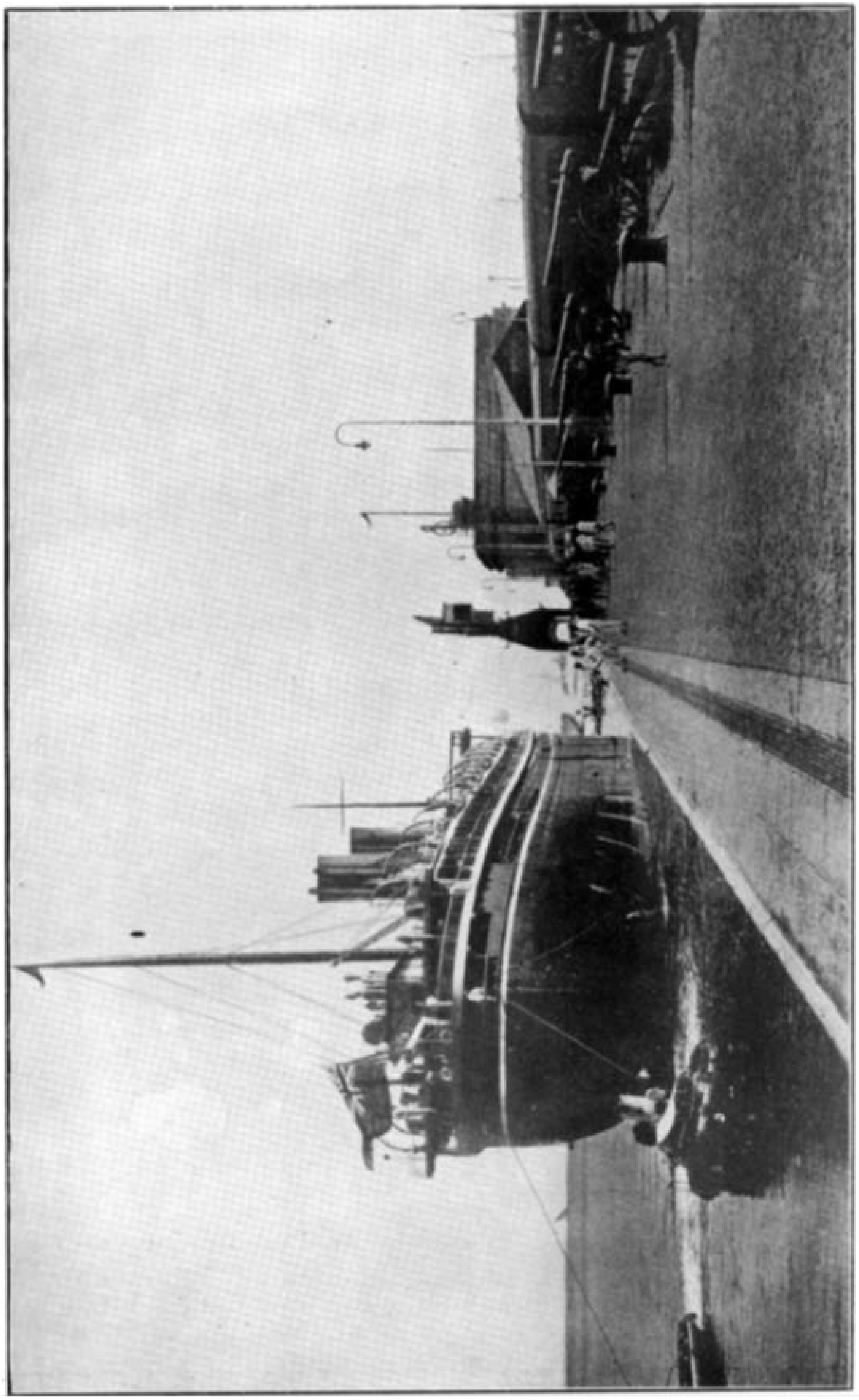
The standard of 33 ft. draft mentioned previously is gradually being worked up to, but the advent of the motor boat has no doubt affected this standard and it is probable that the figure of 33. ft. will not be reached for some considerable time. A motor ship on an extended voyage can, with a somewhat smaller tonnage, carry some 25 per cent. more cargo than a coal-burning steamer. In addition io this, the motor ship has a lower operating cost and these factors will cause more motor ships to be constructed than steamers so that in the near future the former will carry the bulk of the ocean trade. Sixteen years ago the motor vessel was practically unknown and if its advent will prevent, anyhow for some time, the steady increase in draft of vessels, then Port authorities will owe them a debt of gratitude.

I have to acknowledge with thanks the ready help given to me by the various Port authorities in preparing these notes.

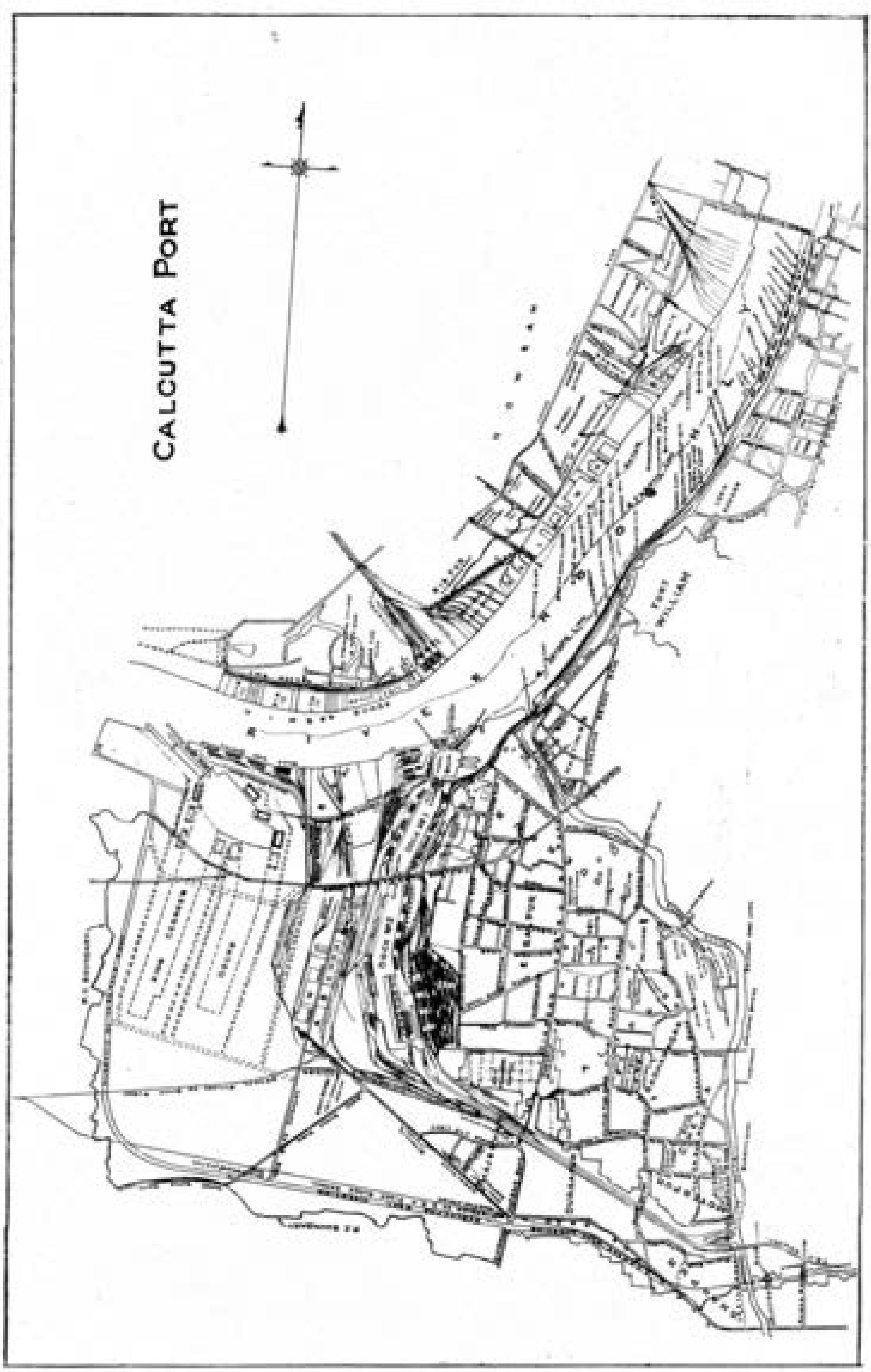
STATEMENT SHOWING INCREASES IN DRAFT AND SIZE OF VESSELS CALLING AT INDIAN PORTS.

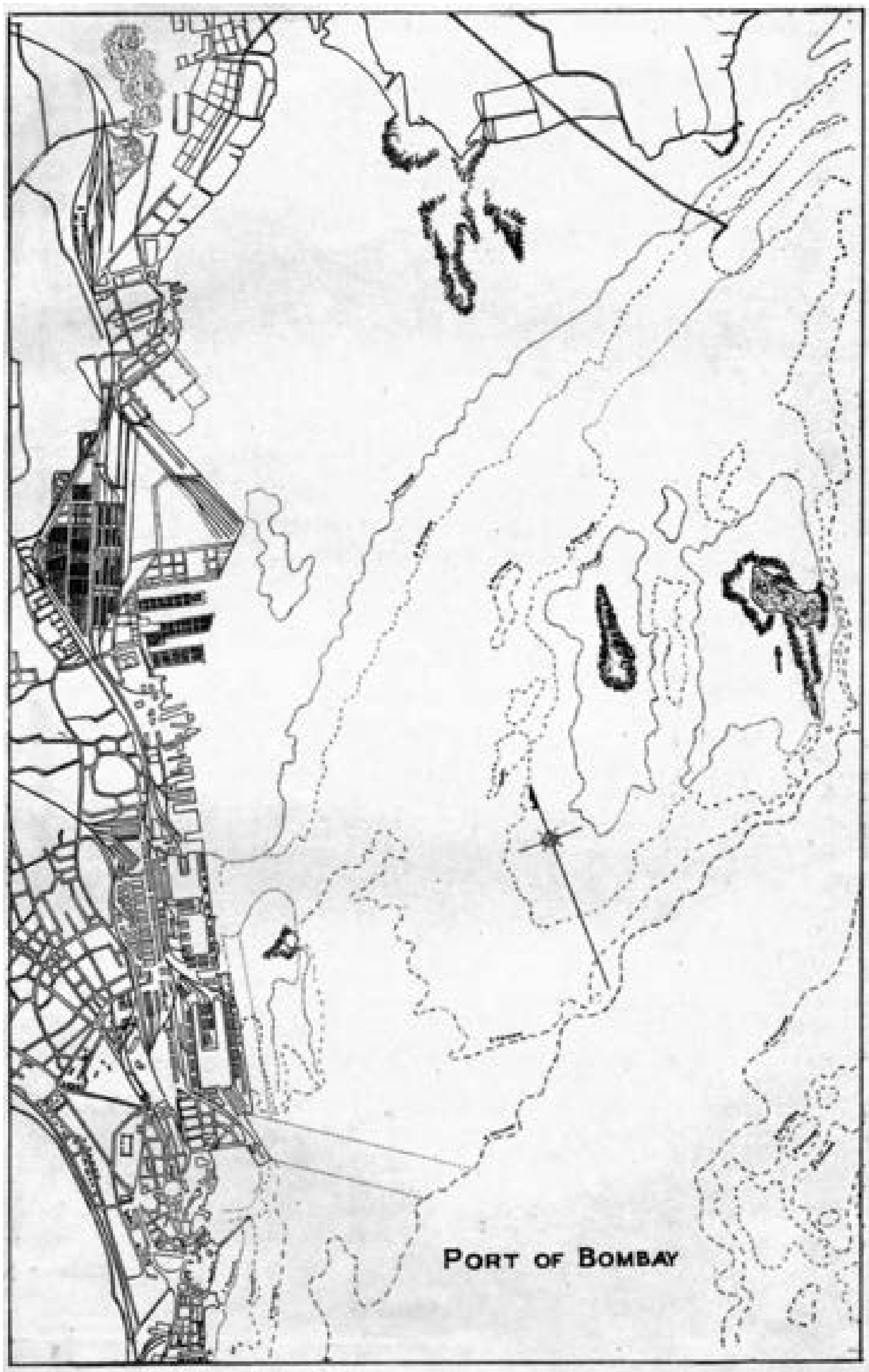
	1910.					1920.					1925.				
DRAFT.	Calcutta.	Bombay.	Karachi.	Rangoon.	Madras.	Calcutta.	Bombay.	Karachi.	Rangoon.	Madras.	Calcutta.	Bombay.	Karachi.	Rangoon.	Madras.
At 25′ and over	227	96	58	124		225	160	41	119	38	196	122	41	215	99
26′ ,, ...	100	48	31	119		196	104	25	147	14	178	101	37	145	43
27′ ,, ...	29	20	9	68		59	43	11	31	5	68	59	20	78	15
28′ ,, ...	6	5	5	29		23	42	14	29	3	41	30	15	63	8
29′ ,, ...	..	3	..	12		2	4	1	35	4	3	10	5	25	2
30′ ,, ...	..	..	..	..		..	3	..	4	..	3	3	..	6	..
31′ ,, ...	..	..	..	..		..	..	..	..	..	..	1	..	1	..
GROSS REGISTERED TONNAGE															
6,000 to 8,000	98	139	45	56	79	176	204	88	99	148	247	264	111	152	208
8,001 to 10,000	5	19	2	5	2	33	91	29	20	12	75	70	27	51	61
10,001 to 12,000	..	7	..	..	..	4	21	..	2	..	5	34	5	9	1
12,001 to 16,000	..	..	..	..	..	..	11	1	..	..	..	3	..	..	..
Over 16,000	..	1	..	1	..	..	10	..	..	..	..	23	..	..	..

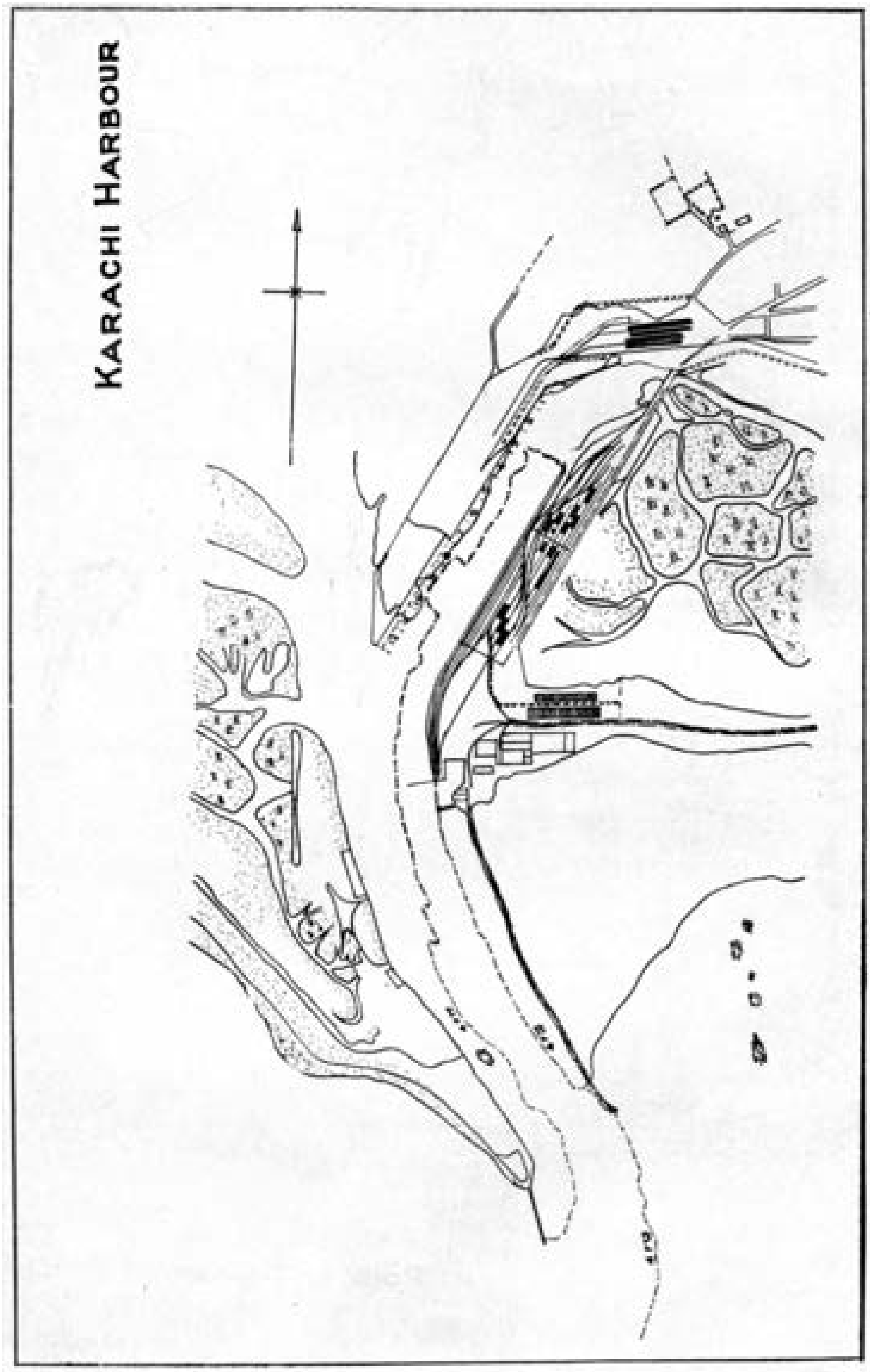

INDIA
SHOWING PORTS AND RAILWAY CONNECTIONS.
AFGHANISTAN
BALUCHISTAN
PERSIA
NEPAL
BHUTAN
BURMA
INDIA
Peshawar
Rawal Pindi
Lahore
DELHI
Karachi
BOMBAY
Poona
Goa
Cochin
Nagpur
MADRAS
CALCUTTA
Chittagong
Rangoon
Andaman Islands
Port Blair
Nicobar Islands
Ceylon
COLOMBO

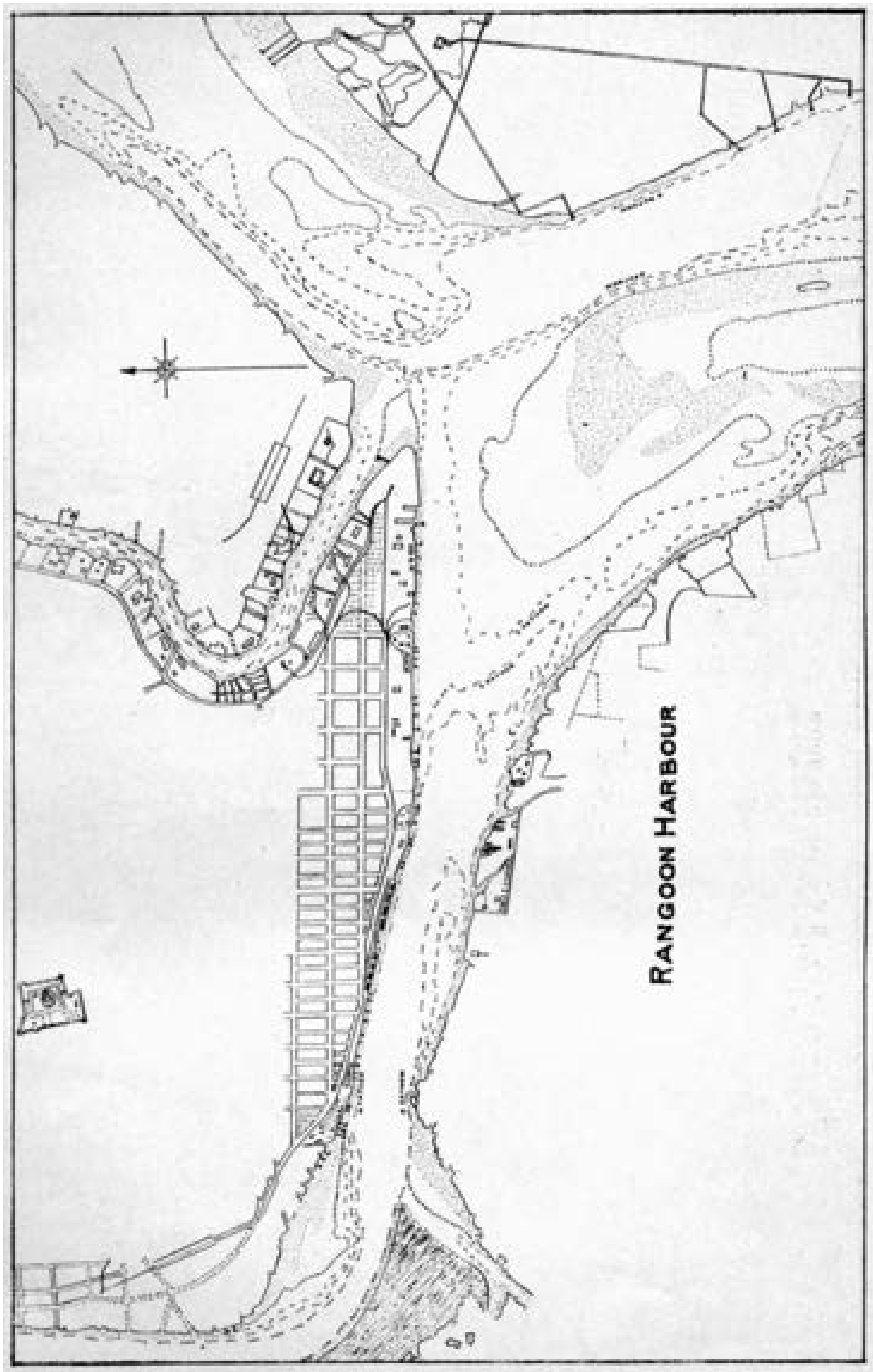


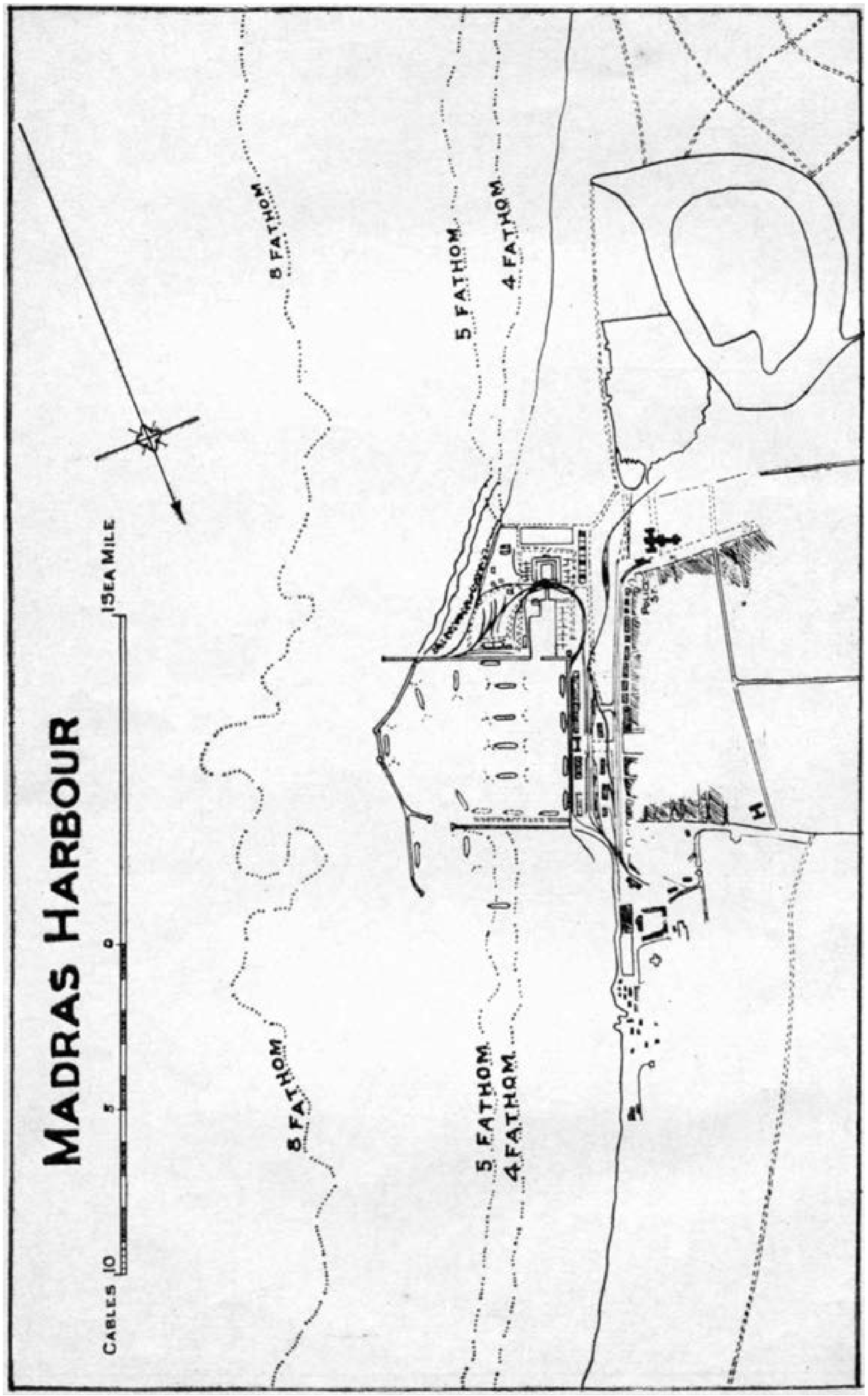
R. M. S. "MOOLTAN" 20,700 Tons, BERTHING AT BALLARD PIER.

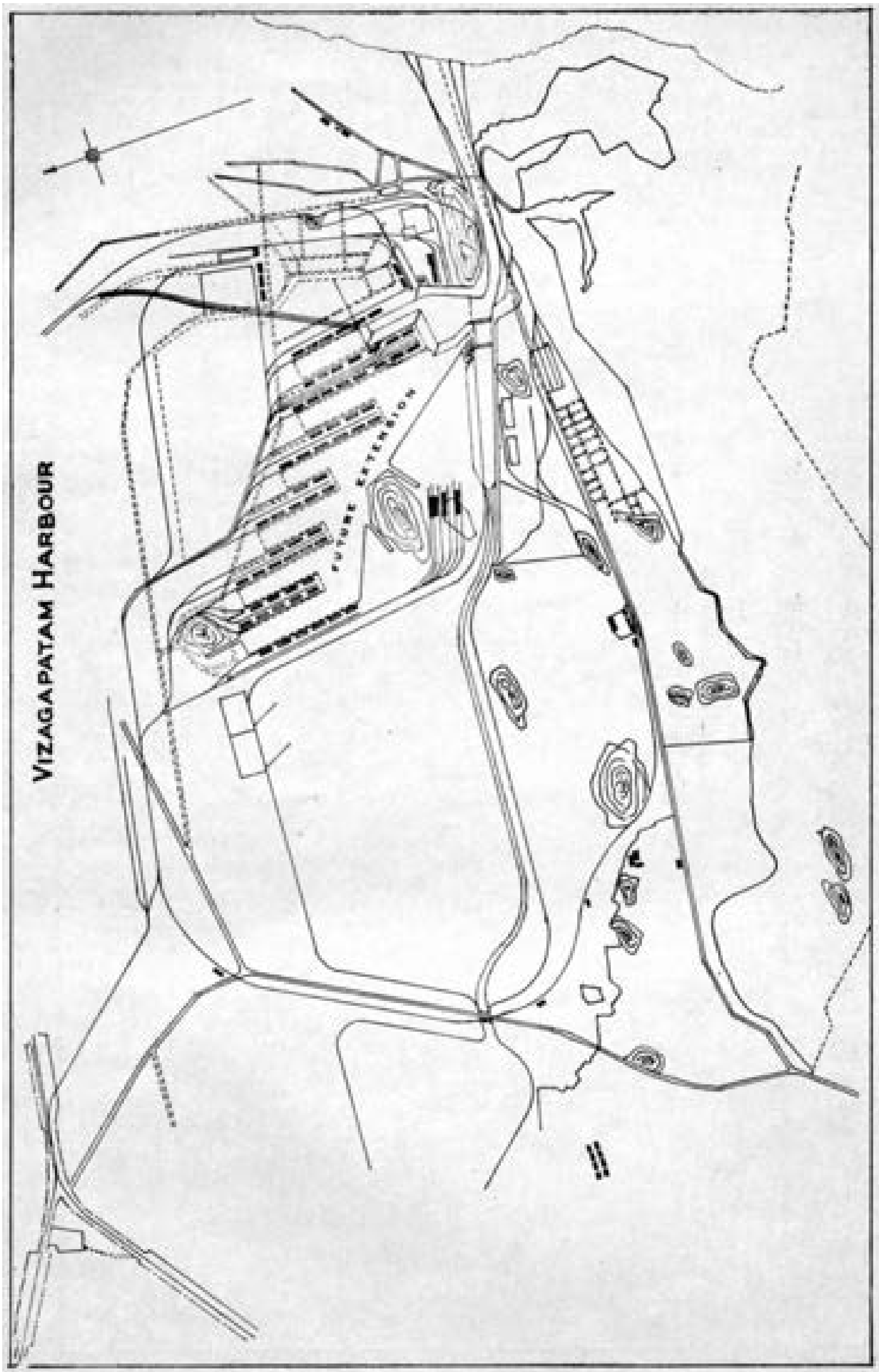

CALCUTTA PORT

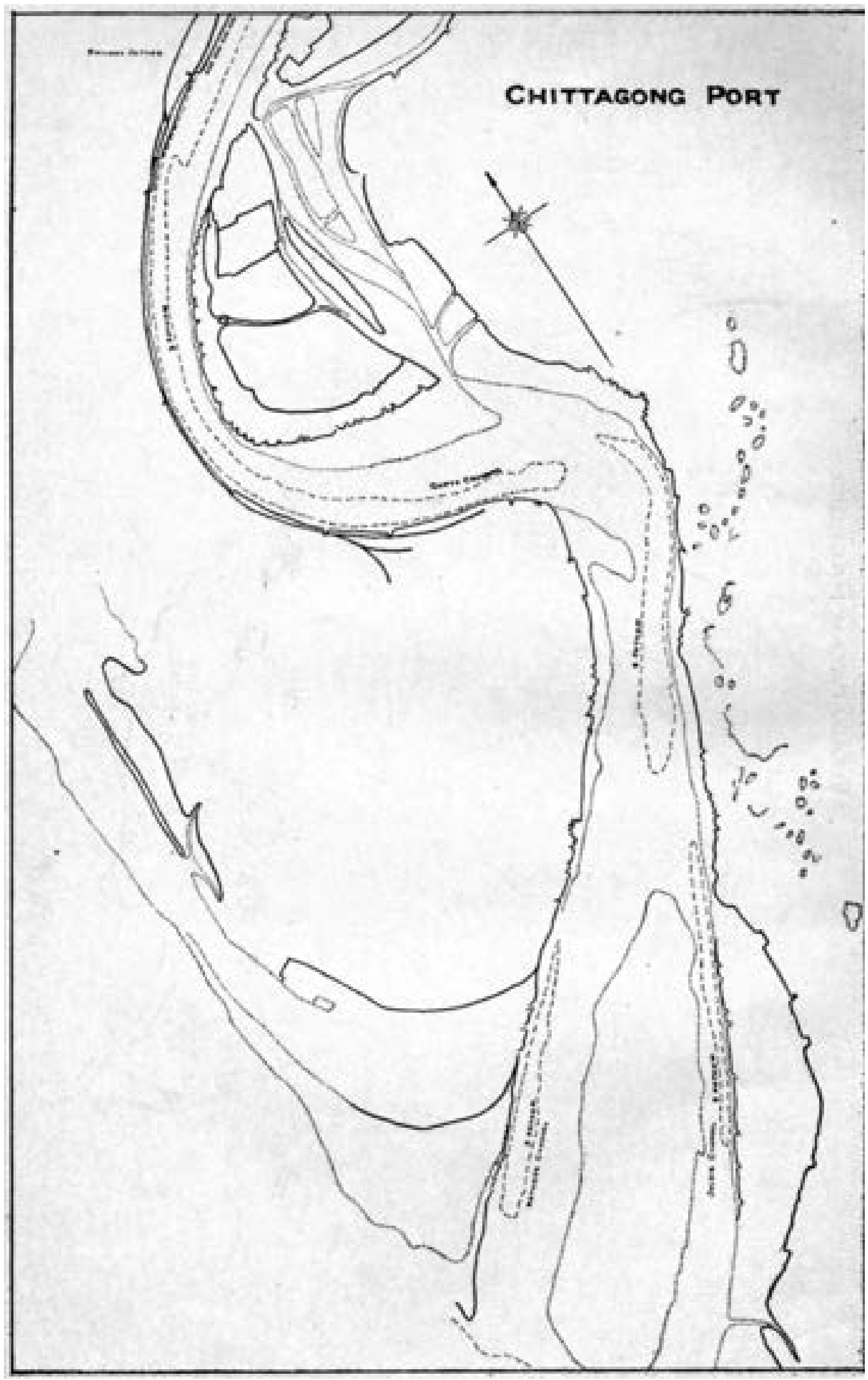

PORT OF BOMBAY

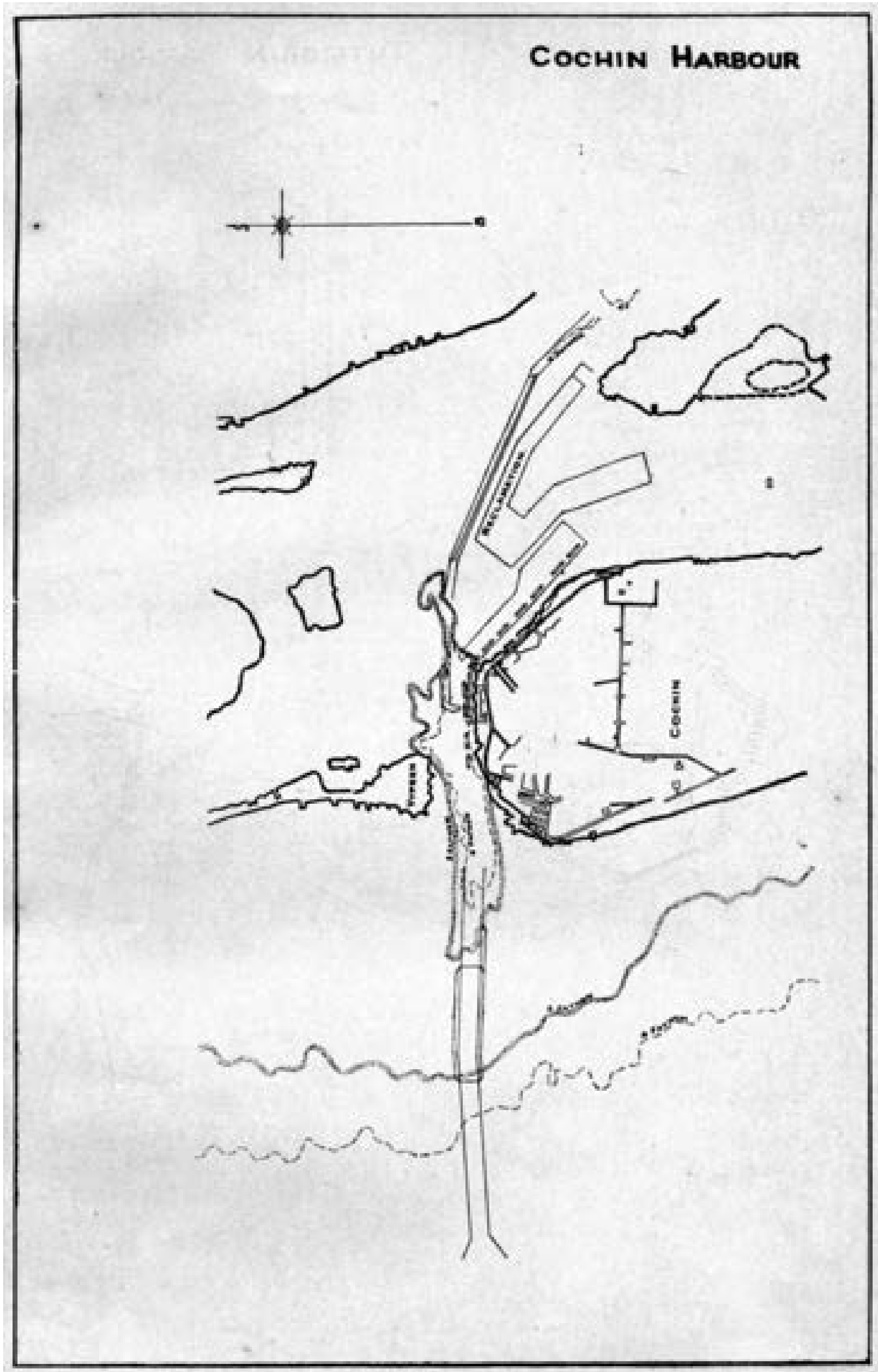

KARACHI HARBOUR

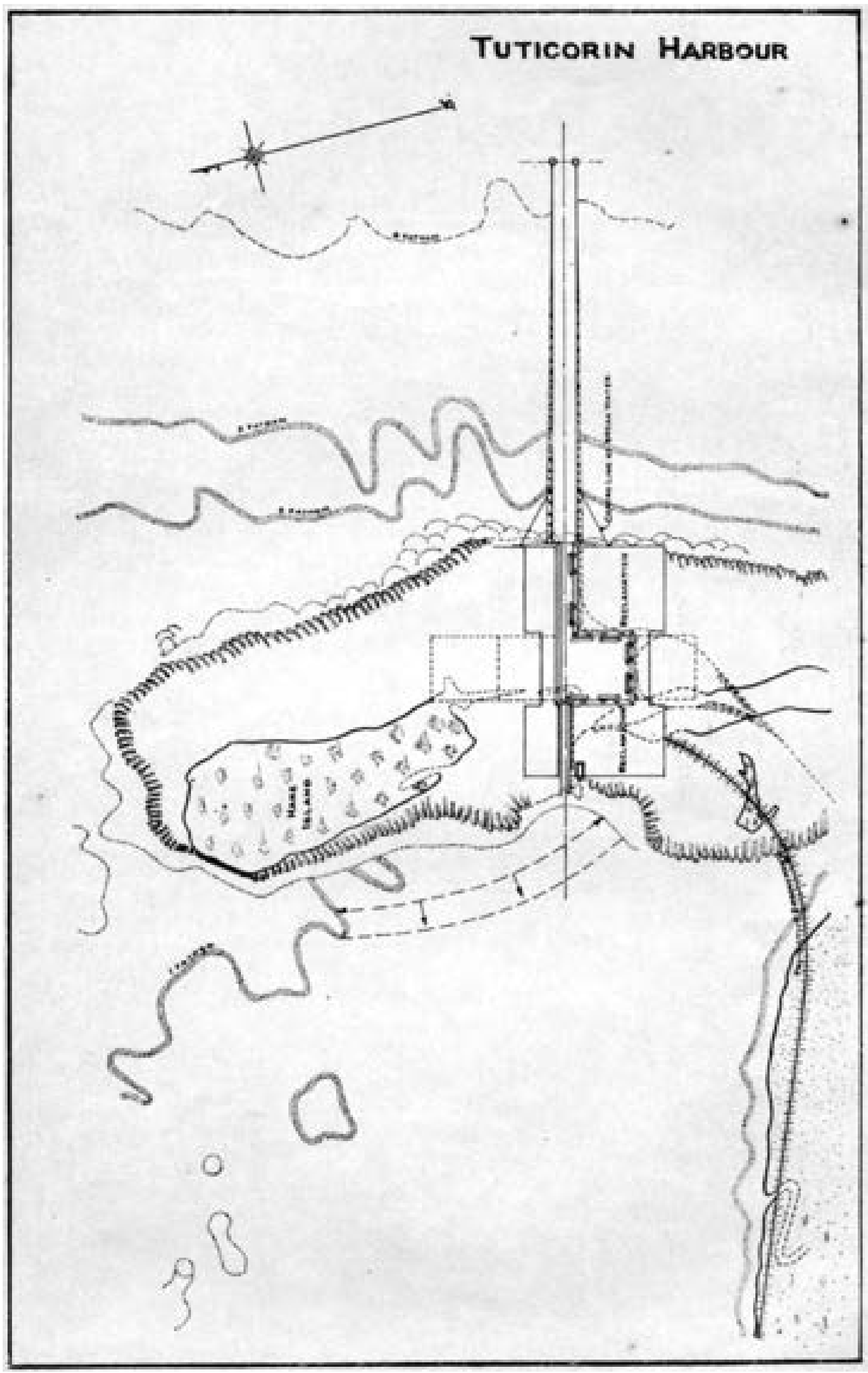

RANGOON HARBOUR

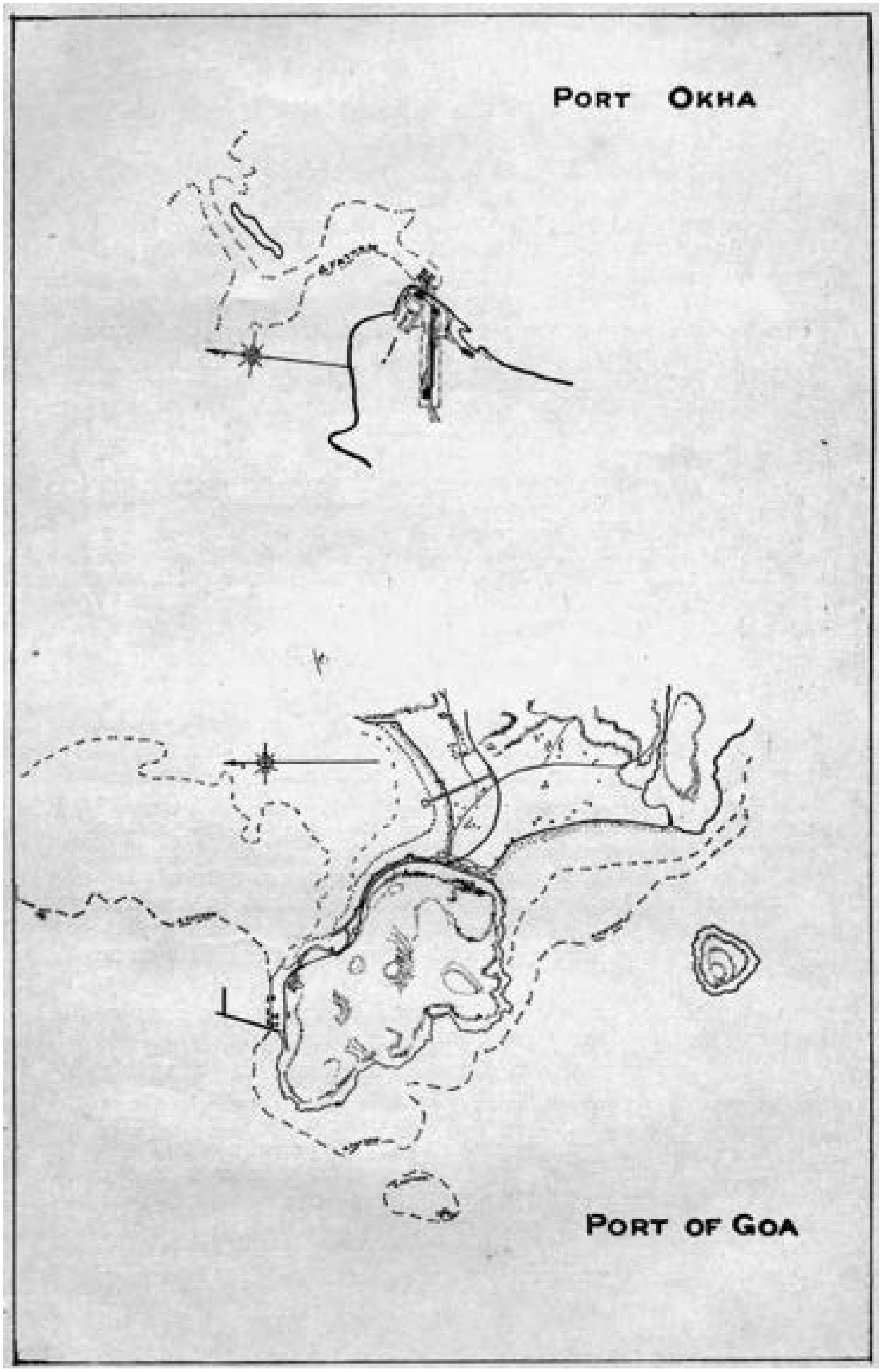

MADRAS HARBOUR
CABLES 10
5
0
1 SEA MILE
8 FATHOM
5 FATHOM
4 FATHOM
8 FATHOM
5 FATHOM
4 FATHOM

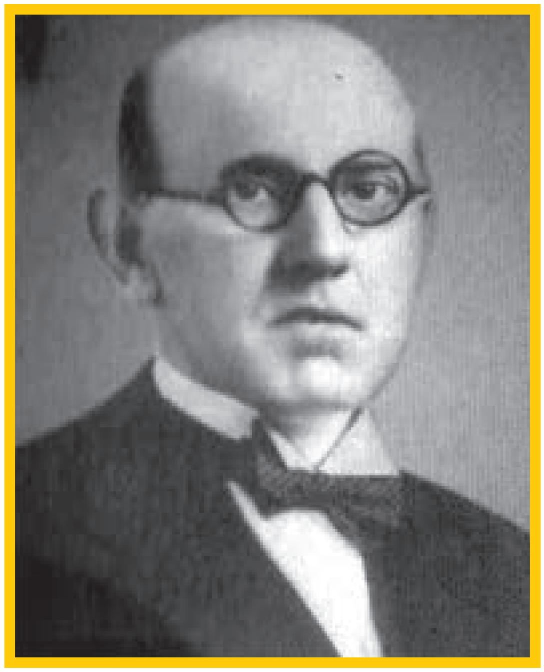

VIZAGAPATAM HARBOUR
FUTURE EXTENSION


CHITTAGONG PORT


COCHIN HARBOUR
COCHIN


TUTICORIN HARBOUR


PORT OKHA
PORT OF GOA



Sir James S Piekeathly

C.I.E., C.B.E., C.V.O., D.S.O.

President 1927-28

Presidential Address

It is my great privilege to address you asx your President for the coming year, and my first duty must be to express my thanks to the Council and members of the Institution for the great honour they have conferred upon me in electing me to this high office. I confess that I take upon myself the duties of this office with some hesitation and doubt whether I can properly fill the position; but one thought comes to comfort me. One of the philosophers said, “The future does not come from before to meet us, but comes streaming up from behind over our heads”. We, therefore, are not responsible to the present generation bit to the future. The success of this presidential year — and we all hope that it be a successful years — will net he upon my shoulders hut upon the broad and capable ones of my distinguished predecessors to whose ungrudging labours the Institution, in a very large measure, owes its position to-day; but on me devolves the duty of doing the utmost of which I am capable to consolidate and extend the work of my predecessors and to advance, in every possible way, the interests of this Institution, to which we are all proud to belong. A distinguished past President of the Institution of Electrical Engineers in one of his addresses likened the position of the President of an Institution such as ours to a spear point or the tool face, and very rightly stated that wheat may be accomplished by the point depends largely on the body behind it. I know your President is always assured of an overflowing measure of support and sympathy from your Council; but, if the good progress made in the past is to be maintained during the coming year, it is essential that the keen interest and support of every member of the Institution should be behind the Council in their labours on your behalf.

The aims and objects, for which this Institution was founded, are set forth in the Memorandum of Association, and are well known to you all. The Institution continues to make good progress, the total membership to-day being 1,033, and the nett increase during the past twelve months 51. The conditions of and qualifications for membership are not being relaxed in any way, but are rather being made more severe. Membership of the Institution is becoming more and more recognised as a qualification and as the hall-mark of the Engineer.

The local associations of Bengal, Bombay, South India and the United Provinces continue to thrive, and during the past year the North West India Association was inaugurated.

Much has been accomplished since the Institution was incorporated in 1920 but much yet remains to be done before the ideals, which inspired the founders, are fully realized; and I want to see and do not hesitate to call for ungrudging service to the Institution from all its Members. I am certain that, if each member will actively realize that the Institution is *his* Institution, its powers of and opportunities for useful service to the Engineering Profession and to the people of this great country will be greatly enlarged. We, members of the Engineering Profession, are justly proud of our splendid tradition of service rendered in many cases regardless of the cost to the server, and I ask that every member of the Institution should to-day put to himself the question “What service can I render to the Institution during the coming year?” In order to help you to answer this question, I propose briefly to indicate the directions in which your assistance is needed, and I feel assured that my appeal to the members of the Institution for help will meet with whole-hearted response.

Each member can help the Institution by bringing its aims and objects prominently before those members of the Engineering profession in India who have not yet felt it to be their duty to join the Institution. As I have already stated, the membership of the Institution now stands at 1,033. This is not unsatisfactory; but there is room in the Institution for many more. I know that there are many Engineers fully qualified for membership whose presence amongst us would add greatly to our strength, but who, for one reason or another, have so far refrained from joining and helping us in our work on behalf of the Engineering Profession in India. By inducing them to do so there is an opportunity to serve the Institution, and I ask each member to appoint himself a missionary on behalf of the Institution, and in season and out of season bring its aims and objects prominently before those engineers of his acquaintance whose help and support we are not at present able to enlist. I am sure that, if an intensive effort is made during the coming year, our membership can be very substantially increased and the opportunities. for good work which the Institution possesses can be still further extended.

You will note from the clause 3c of the Memorandum of Association that one of the objects for which the Institution has been established is “to diffuse among its members all information on matters affecting Engineering, and to encourage, assist and extend knowledge and information connected therewith by establishment and promotion of lectures, discussion or correspondence”. Now, the records in the Journal of this Institution show that since its formation. a number of valuable and interesting papers on matters connected with Engineering have been submitted by members of the Institution and discussed either at the meetings of the local association or the parent body; but it is a matter of great regret to your Council and myself that no papers are available for discussion at this meeting. If the Institution is to fulfil one of the most important objects for which it was founded, members must bestir themselves and, even at the sacrifice of some of their leisure time, undertake the preparation of papers dealing with engineering matters with which they are most conversant. I am aware that, as a class, the members of the Engineering Profession are usually unduly modest, and many feel that: the works executed by them are not of sufficient importance to be worthy of a paper; others may feel that the difficulties encountered by them in carrying out works were capable of very simple solutions when carefully examined, and the matter is not of a sufficient importance to justify the preparation of a paper for the Institution. But here I think they make a mistake. It is only by explaining the difficulties which we have met and the methods adopted to surmount them that we can hope to pass on our experience to others and so fulfil one of the main objects for which the Institution was founded. There is no country in the world with a larger variety of engineering work in progress than India, and many engineering problems and difficulties have constantly to be surmounted; and I appeal to all members, who may be in a position to help, not to allow a little trouble or sacrifice of time to stand in the way of this most important service to the Institution. If members shirk this service and a steady flow of suitable papers dealing with matters of professional interest is not maintained, then the usefulness of the Institution will be grievously impaired, as it will fail to serve one of the principal objects for which it was founded; but I have no fear that this will be the case, as I am confident that my appeal will not go unheeded.

I have briefly indicated above two directions in which each member may serve the Institution; but there is another direction in which even greater opportunities exist for service to the Institution and our profession. Sir Clement Hindley referred to it in his presidential address in 1922, and I feel I need make no apology for quoting the words used by him on that occasion. He said, "A very great responsibility lies on every Engineer who is entrusted with the practical training of the students or apprentices. It is here that his opportunity for service to the Institution and the profession lies, and it is here that the greatest necessity exists for a realisation of those ideals of which I have been speaking". These are wise and weighty words, and J sometimes wonder if we fully realise our responsibilities to the rising generation and if each one of us is doing his utmost to discharge these responsibilities to the best of his abilities. In the course of time the students of to-day will be called upon to take the reins from the hands of those who now occupy the premier positions and if young men are to carry on the traditions and maintain the high standard of our profession, it is essential they should receive all the guidance, sympathy and support that may be necessary for their welfare and advancement. In this matter of vital importance the work is one which, to a great extent, must be left in the hands of individual members. I know that many members of the Institution have given unsparingly of their time and interest to this work, but lest any of our members have overlooked their obligations to the Institution and the young engineers with whom they are brought into contact, I commend to their notice the great opportunity which this work offers of rendering useful and lasting service to our Profession.

At the risk of incurring the criticism of making an unsuccessful attempt to preach a sermon instead of delivering a Presidential Address, I propose to take this opportunity to address a few words to the students and younger members of the Institution. It was my privilege some years ago to read two addresses, one delivered by Mr. C. H. Wordingham to the London Students' Section of the Institution of Electrical Engineers, and another by Dr. E. H. Griffiths, F.R.S., to the South Wales Institute .of Engineers. These addresses made such a deep and lasting impression on me that I feel I can render no better service to the young men of our profession to-day than to tell them some of the things the lecturers said. Speaking to the students Mr. Wordingham said —

"Most of you are starting, or have just started, on your careers: what is necessary for your success? Naturally you must be equipped with the very best scientific and technical education you can obtain. Subject possibly to the exception of a few brilliant men with inborn genius who do arise from time to time, the day has gone by when the man who picked up his knowledge as he went along can hope to attain a good position as an engineer. Every young man entering the profession must make himself acquainted with the present state of knowledge in the various branches, and must have a special knowledge of the one in which he proposes to practise. This knowledge, however, is only his bag of tools. The finest kit in the world will not carry him far if he does not know how to use them, It is in the use of them that the human element comes in and that the exercise is called for of such abstract qualities as sympathy, kindliness, consideration, firmness, fairness and honour. These are the determining factors. The works manager who has favourites, who tries to get the better of his men, who bullies and insults those under him, or truckles to a dishonest employer by allowing scamped work, will never be a success. The adviser whose advice is coloured by his own self-interest, or who is open to improper influences, may make money, but he will never attain an honourable position. The staff man whose heart is in his amusements and who only does so much work as he is compelled, doing it as an uncongenial task to be put out of mind when he puts on his hat, will find his promotion slow and his change of employment frequent.

"It is the man himself who counts. He must have his equipment of knowledge and skill, but also he must be able to use that equipment.

"Just one word on the subject of work. The fashion of the day is to exalt amusement as the chief aim in life, and to represent work as a task to be reduced to the shortest period possible. So far have things gone that a man's opportunity to work is in certain directions forcibly limited by Act of Parliament. Work is essential to our existence, and it behoves each one of us to find out, for himself what kind of work he is best suited to perform and then to find means to make it his vocation. Ordinarily, many drift into their life's work, but I imagine that few drift into engineering; most enter the profession from deliberate choice, presumably because it attracts them. Fortunate indeed are they if they have correctly gauged their inclination, for the true engineer needs no artificial amusement, his work is his hobby and is seldom out of his mind, even when taking, as he should, legitimate relaxation.

"Most of us must have asked ourselves at one time or another: What is man's ultimate destiny? What are we here for? Each must find his own answer. I suggest that one of the most important objects in life is the formation of character, and if this be so, every thought, every action has its effect, indelible and permanent. Every job carried out then assumes an importance far greater than its intrinsic worth would give it. The primary thought in every engineer's mind should be: 'Will this thing which I am carrying out be to my credit as an engineer or to my discredit? Suppose the work which I am doing to-day, and which will soon be out of sight, is unearthed 20 years hence, will its discoverer say of it that the job was well done or scamped?' I know of no pleasanter sensation than that of revisiting something carried out years ago and being able to tell oneself that it has stood the test of time and is still functioning well. I would say to each of you: 'Try to do every piece of work primarily for the work's own sake and for the sake of its effect on your Own character. The pecuniary reward in any one instance may be small or great, but in the long run that too will be added to you.' . . . . . A duty accomplished, a difficulty successfully overcome, a job well done, these are the things which confer real happiness, happiness worthy of man with his infinite possibilities and responsibilities".

Dr. Griffiths ended an address on the subject: "A closer union between pure and applied science" with these words :—

"There is no branch of natural science which the engineer can afford to ignore. His dependence on the physicist, the chemist, and the geologist is obvious, but I ask you to remember that the successful construction of the Panama Canal was due to the researches of zoologists, and even the designers of our aeroplanes had to call on the botanists for advice in the selection of their wing materials.

"The increasing complexity of the problems by which we are confronted—or rather our increased knowledge of their complexity— has led to the division of science into separate compartments, a separation which was inevitable although in some respects regrettable. Nevertheless we must remember that they are all parts of one organic whole. The laws of conservation and dissipation of energy, for example, are not bounded in their application by the walls of a physical laboratory. No worker in any one such compartment can afford to be ignorant of discoveries made in others, and more especially is this true of the engineer. It appears to me that one of our difficulties is the tendency to over-specialisation. The engineer should have easy access to all chambers in the temple of science.

"It is true that the views I have expressed may be regarded as Utopian, or, if you prefer it, optimistic and imaginative. I am unrepentant! I want to induce our young engineers to be both optimistic and imaginative.

“I delight in the following quotation from an address given to the Royal Society by Sir Benjamin Brodie in 1859: 'Physical investigation more than anything besides helps to teach us the actual value and right use of imagination—that wonderful faculty, which, left to ramble uncontrolled, leads us to stray in the wilderness of perplexity and error, a land of mists and shadows, which, properly controlled by experience and reflection, becomes the noblest attribute of man, the source of poetic genius, the instrument of discovery in science, without the aid of which Newton would never have invented fluxions, nor Davy have decomposed the earth's alkalies, nor Columbus have found a New Continent.’

“I venture to repeat, at the risk of being that thought wearisome, the mental attitude of our young engineers towards the revelations of pure science should not be 'What possible use can there be in this discovery?' but rather 'What is the way in which this discovery can be utilised?' I would urge you in your leisure hours—and I admit they may be few—to study the works of the pioneers in pure science, and as you do so give free play to your imagination, always bearing in mind the words of Sir Benjamin Brodie: 'Imagination properly controlled by experience and reflection.' Waste not your efforts in vain pursuit of impossibilities, such as the squaring of the circle and perpetual motion; but build on the firm foundations laid for you by the masters of research, and strive to apply the principles they have established to the benefit: and advancement of mankind.

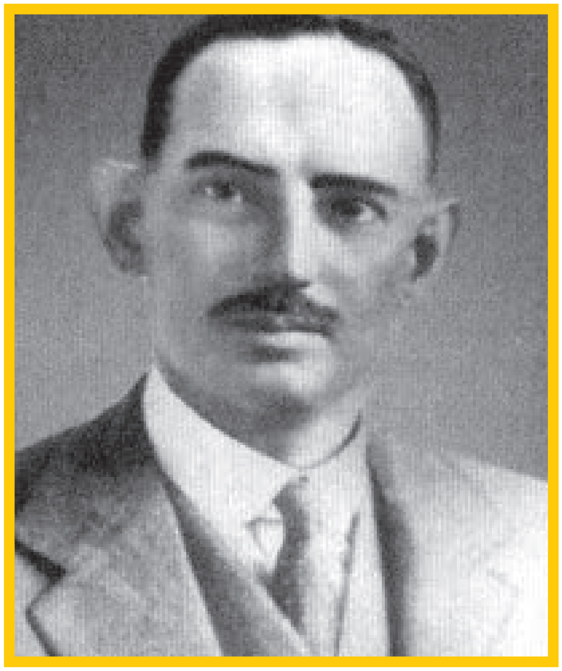
“Determine that you will become liaison officers between the allied armies of pure and applied science. To the man of science, discoveries are an end in themselves; by the engineer they should be regarded as foundations on which he may surely build for the edification of mankind.

“I will close with the words, better than I could frame: ‘There are three voices of Nature. She joins hands with us and says, Struggle, Endeavour. She comes close to us ; we can hear her heart beating. She says, Wonder, Enjoy, Revere. She whispers secrets to us. We cannot always catch her words. She says, Search, Inquire. These, then, are the three voices of Nature, appealing to Hand, and Heart, and Head, to the Trinity of our Being.’ ”

No better advice has ever been given to young men starting their careers in the Engineering Profession than that contained in these quotations, and I hope that the students and younger Members of the Institution will find in these words inspiration and incentive to selfless service. Your profession has pre-eminently a boundless scope for service. The vastness of its domains and the strength of its influences provide inspiration to endeavour which, I feel sure, will sustain you when travelling the road which lies before you. I ask you to regard the Institution as an embodiment of the principles so well expressed by the distinguished men whose words I have borrowed; and I can point you no higher aim than that the proper exercise of your profession and the right conduct of your lives should serve as a mirror reflecting those principles.

Now the proper exercise of your profession, and indeed) of any profession, implies something more than just “pulling your weight”. As engineers, you will understand that maximum effort can only be exerted if the individual forces act in unison. In other words, it enjoins unselfish team work. Success and honours will not come to all of you; nor would I have you measure merit solely by this standard. As your work draws to its end and as you retrace the difficulties of the way which you have traversed, you will come to pass judgment on yourselves; and, if you are able justly to conclude that, ‘I have given freely and unselfishly to the team,’ you can find no fairer capital to crown your life's. work.

And now I shall end with an earnest appeal to you all that you should, at all times and in every way, apply the high principles and traditions of your profession so to help to direct the course of events that this great country shall go up, and not down, in the scale of humanity, and in its upward progress shall be an agent for the uplifting of mankind at large.



Lt Col R D T Alexander

D.S.O., O.B.E., T.D.

President 1928-29

Presidential Address

Gentleman

In this Presidential address, the first thing I wish to do is to thank you for the very high honour you have done me by electing me as President of the Institution for 1928-29. This is an honour which I very greatly appreciate and for my pad; you may be sure that I will do all I possibly can to further the interests of the Institution during my term of office.

My predecessors have, as a rule, on this occasion either addressed this meeting on the activities of the Institution, the training of young Engineers or on some Engineering subject. In my address to-day, I wish to deal in particular with the position and responsibilities of the Local Associations.

The President of an Institution like ours has a great responsibility to shoulder and I feel that the best results cannot be obtained unless he takes members into his confidence and obtains their help continuously. I intend to take you into my confidence to-day and ask you to help to extend the activities of the Local Associations. We must contrive to make all the Local Associations real live organizations and to dispel any ideas of misunderstanding which may exist.

To start with I want you all to realize that tire Local Associations are the Institution of Engineers (India) in being and that it is on the success of each and everyone of the Local Associations that the success of the Institution as a, whole depends. I should perhaps explain that apart from the office where the Secretary and his staff carry out their work, the Institution has no existence except in its Local Associations.

In some Provinces, there is apparently an idea that the Local Associations are not really part of the Institution but are more or less independent bodies attached in some vague but undefined way to the Institution.

I understand that some Local Associations imagine that the funds which they are entitled to receive from the Institution are dependent entirely on their membership and that they should manually demand a sum of money equivalent to so much per head of their membership.

Neither of these ideas are correct and I wish to impress on you to-day that the Local Association is the Institution of Engineers (India) in that particular Province. Secondly that in so far as it is within the financial power of the Institution, each Local Association will receive that amount of money required for its expenditure during the year-no more and no less.

To facilitate this question of finance, each Local Association should, as soon as possible after the 1st of September in each year, send to the Secretary of the Institution a budget of their proposed expenditure. This will be considered by the Council and, if passed, then the money, will be allotted to that Local Association. Yon will, however realize that it would be bad finance for the, ln Institution to transmit a considerable sum of money to the Local Association until it is actually required.

I should like to point out that at present the annual expenditure of the Institution is from Rs. 6,000 to Rs. 7,000 in excess of the money it receives. So far we have been working on overdraft against our reserve and I feel sure that yon will, agree that it would he burl finance to send to each Local Association a lump-klint of money at the beginning of the year and thereby increase our overdraft on the bank on which we have to pay interest. I therefore suggest that this difficulty can best be got over by the Local Associations working on an Imprest Account which will be recouped from time to time as may he required. I trust that I have made the two points clear, viz:-

(1) That the Local Associations are the Institution of Engineers (India) in their respective Provinces.

(2) That the money which they are entitled to receive should be equivalent to their approved expenditure and no more and no less. No Local Association should at the end of a year have either a credit or debit balance.

I hope that I have cleared up these two points and now let us see how we can improve the activities of the Local Associations.

I know from experience that the general failing of all men is to put on to the busiest man any extra work that is going. Honorary Secretaries of Local Associations are not apparently exempt from this failing of their fellows and we usually find that the Honorary Secretary of a Local Association is one of the hardest worked men in the Province. It is very difficult indeed for any one who has to work long hours in his own sphere of activity to devote the time necessary for carrying on efficiently the work required from an Honorary Secretary of a Local Association and I think it is asking an impossibility unless efficient help be given to that gentleman who consents to take on these duties. As I have already said the Local Associations are the Institution of Engineers (India) in being and it is of vital importance that everything possible be done to give those Local Associations a reasonable chance of performing their share in the organization. The correspondence necessary to do this is very great and is in my opinion overwhelming for .anyone who has other duties to perform unless he be given efficient assistants. I therefore think it advisable that each Local Association should, in addition to the Honorary Secretary, have a paid well-educated Head-clerk who will be able to do the routine work and thereby give the Honorary Secretary time to plan arrangements for increasing the efficiency and popularity of the Local Associations.

You may think that the above remarks are rather on the lines of a sermon but I can assure you, gentlemen, that I have the interests of the Institution very much at heart and I feel that if we are to take our place amongst the great technical institutions of the world, we have to make a really serious effort now and that effort must be made by each of the Local Associations.

In connexion with this matter I would remind you that one of the greatest difficulties with which our Institution has to, contend at present is that of finance. You have seen the balance sheet and you all know that our annual income does not meet our expenditure. There are two ways of remedying this:-

(i) by raising the annual subscription

and

(ii) by obtaining increased membership

I think it would be a very retrograde step indeed to raise the annual subscription but I do feel that there is considerable scope for increasing our membership. I am not for one moment suggesting that the standard of admission to the Institution should be lowered in the very least degree but there are many Engineers in India who are fully qualified and who do not at present belong to the Institution. These Engineers in common with those who belong to the Institution obtain their livelihood by work in India and it is surely their duty to support the Institution which has done so much to foster engineering interests and to maintain engineering standards in this country.

I am sure that everyone of us here knows several qualified Engineers who do not belong to the Institution and I would therefore ask you to point out to these gentlemen what they are missing by not belonging to it and the path in which their duty lies.

I do not wish you to think that I am asking you to beg people to join the Institution, but what I do ask you is that you will tell your qualified Engineer friends about the Institution and let them know the advantages to be gained by both themselves and by India as a whole if they come forward and join. I am perfectly certain that the reason why those qualified Engineers who are not members do not belong to the Institution is that they have never been told anything about it. If each of you will help me by shouldering a little of the work, the Institution will, in a short time, be in a very flourishing condition indeed. Please however keep this uppermost in your minds— the Local Associations are the Institution of Engineers (India) in being and if each is a real live organization, then the Institution as a whole will fill the part for which it exists.

Lieut.- Genl Sir Edwin H. De Vere Atkinson

K.C.B., K.B.E., C.M.G., C.I.E., R.E.

President 1929-30

Presidential Address

Gentleman

It is a customary act of courtesy for a new President to express his thanks for his selection for the position of President, In my case it is more than an act of courtesy. I came out to India in 1888 and a long career and good fortune has attached many letters, to my name, but I can assure you that no honour has given me greater pleasure than that done by you in selecting me for a post which has been field by such eminent Engineers in the past. Gentlemen, I thank you with a full heart for what I consider is all honoured ending to a long career associated with Engineering in India.

When I first arrived in India 41 years ago the general position ill the Engineering World ill India was very different to that existing at the present time. There was the P.W.D. consisting of the Roads and Buildings and Irrigation, the Railways and the Military Works Department organized on the same line as the P.W.D., with divisions, Executive and Superintending Engineers, etc. In my Department every Engineer had to be Jack of all trades, which as you know, is not an efficient or even possible state of affairs, He had to be a designer, estimator, architect, sanitary engineer and builder, etc.—all in one. I believe there was appointed some years later one architect for the whole of India, the Consulting Architect of the Government of India. The expansion necessitated by the ever increasing efficiency of modern life has changed all this. We have now specialists in their own lines with a basis of a common training in Engineering.

On the Electrical side the expansion has been enormous. At the commencement of the Great

War in 1914, I think there were only two military cantonments electrified and now there are over eighty. The great developments in Hydro-Electric Schemes are acting as spurs to the industrial development so badly required in India.

The Irrigation Department which has produced results unparalleled in the history of the world has not rested on its laurels, and among modern schemes, this province is providing some of the grandest works which we hope will be of immense potential advantage to the inhabitants. Nowadays the Sanitary Engineer, the Town Planner, the Agricultural Engineer all take their specialized part in the work that used to be done by the Jack of all trades in the past.

Why have all these posts and Departments sprung up; because, Gentlemen, it pays.

These men have not been engaged as expensive fads. Experience has proved to every Government that it pays to provide first class Engineers in every branch of public affairs.

If the Town Planner had come in time, what a large amount of money, and lives would have been saved which have been lost owing to the haphazard, insanitary, and congested state of many of India's towns.

To increase the material prosperity of this country one of the crying needs is Industrial Development, and Industrial Development requires money, energy, initiative and engineering. Not only have mills and factories to be built but the machinery has to lie made and installed and run by Engineers. Further Railway development, and a forward policy in transportation, is not only necessary but essential to the improvement of the industrial, commercial and social prosperity of the country.

I fear that even to-day every Engineering student looks forward only to Government employment. These enormous Departments do not exist in many other countries where the Engineer has to find his own work and do it to the satisfaction of his employers or he win not continue to do work. I have been for years and years preaching to all my Indian friends and students, in company with many other people, that it is by private initiative that the Engineering profession can best foster the industrial prosperity of India, and the most remarkable example of this is one of our distinguished past Presidents Sir Rajendranath Mookerjee.

One of the objects of this Institution is to maintain the highest standard in Engineering in India. History and actual results show that in the past Engineers in India have been second to none and this Institution has made one of its first principles that it is determined to maintain the high ideals always kept up by the Parent Institutions in the West.

We scrutinize most carefully each application for membership, we fix the standard of the examination, and we refuse to accept the diplomas of Institutions whose courses we consider weak. Is it possible we could do more? Remember that the lad grows into the man and it is the student who is ultimately the Engineer. Can we suggest to Local Governments the advisability of letting the Institution be the Adviser and Assessor of tile standard of the curriculum and courses of all the Engineering Colleges and Institutions in India. Is this practicable or is it a Castle in Spain?

As regards Mechanical and Electrical Engineering, I think the problem of employment is by far the most difficult. It is undoubtedly hard for Indians to get the right kind of practical training and instructions in the West to fit them for managing and supervising posts in Mechanical and Electrical Engineering work.

I have been much perplexed over the question of Indianization in our 9 Army factories. The work required is often one involving great precision and immensely varied. It ranges from the making of explosives, ammunition, guns, rifles, steel, etc., through an enormous range of articles, to clothing and ghee. The workmen arc all Indians and many very good and by a system of apprentice training we are now turning out an excellent class of trained apprentices. The trouble is the supervising classes ranging from Chargemen to Foremen. To a great extent these men have at present to be especially brought out from Home, as real knowledge of the manufacture of lethal weapons and Army equipment can only be obtained at Home. From experience I personally consider that for an Indian to go Home and obtain an engineering degree and then a smattering of practical work is a waste of time and money. Factories whether Government or not cannot exist, unless efficiently and economically managed, and technical knowledge of a high order is necessary in supervision.

Now the best of our apprentices, if they had two years improver training, would make excellent Chargemen and many of these would doubtless ultimately work their way up to Foremen, but the trouble is that on the conclusion of their apprenticeship they want to be Chargelrnen straightaway, a job they are not yet fit for. I propose to send the best of these Home for two years to work as Improvers. The spirit in which I wish their training to be carried out is: Practical training in methods of manufacture is immesurably more important than academic qualifications, but our aim is not only to increase the mechanical and technical experience of the lads, but also to develop their personality, broaden their outlook and character by travelling in a new country, competing with workmen whose views are different to their own, and seeing different workshops and supervising methods. For this purpose we do not want our lads to be too dependent on financial assistance from Government ; we do not want them to be premium improvers ; we do not want them to stay in sheltered trades; we do want them to meet with and overcome difficulties and we do want them to earn their keep in competition with English workmen as far as possible. Then further, when a special outstanding lad, qualified by birth, character and personality, is forthcoming I propose to send him on after the improver class to a University to obtain it degree, and join the works management.

Whether these ideals are too high and impracticable is a matter of argument and I have not yet succeeded in persuading the powers that be, that they are practicable and on the right lines.

It may interest you to hear the details of one case which have just come to my notice, of one of our apprentices from the Gun Carriage Factory at Jubbulpore who went Home at his own expense and for whom we found work in Vickers in England. He has just finished 3 years as an improver on the lines I have sketched out. His average earnings the first year were £3.15 per week, the second year £4.15 and the third year £5.15, making a total earned of £728. His total expenses excluding passages but including lodgings, wearing apparel, sports, week-ends ill England, continental trips, presents and all expenses were £542. In his last letter he finishes "I am really very sorry to leave England, and I was much upset while parting with my many acquaintances and fellow workers and staff who in different sections gave me farewall and presents. I had a long talk with Mr. Wilson, Superintendent and managers". Well, Gentlemen, this shows what can be done, if work is done in the right spirit.

I am as keen on Indianization a any one. I recognize this is the country of the Indian and they have the right to expect the major share in all positions of work, responsibility and administration. But I am only keen on Indianization on the right lines. The Indian must educate himself and be trained efficiently to hold down the posts to which he lays claim, and the difficulty is that so-called popular opinion, and very frequently nepotism, demands that an Indian must be put into a post because he is an Indian and not because he is qualified to carry out the work as efficiently as others.

Army factories are undoubtedly in a stronger position than civilian establishments, as efficiency with them is a necessity, as they have to work to recognized standards as long as an Army exists in India under British guidance. The Army standard is firstly, the cheapest standard to which an article can be turned out, which will ensure, I reasonable life, when in the hands of troops, and which will further endure the hard treatment it must meet in the field during an actual campaign; and secondly in many cases the standard has to be guided by the standard of the British Army , as all articles of equipment in the hands of British troops in Ind ill must be inter-changeable and the components inter-changeable with like components in the hands of the British Army elsewhere. For instance, all the components of guns and rifles made at Cossipore and Ishapore must be inter-changeable with those manufactured at Woolwich or Enfield.

We are often defeated by the troops themselves if the greatest care is not taken. For instance, all components of a machine gun are made to average limits of 1 to 2000th of an inch to give them a reasonable life, recognizing they have an enormous amount of wear in the daily operations of training and firing. Consequently a new gun is a good fit and stiff. A machine gun section used to be trained to get their gun into action in 20 seconds and out of action in 15 seconds. This is impossible with a stiff gun and consequently they used to file down all the recalcitrant parts. This order has been altered and no time is now fixed for either operation.

Now, Gentlemen, a few words on the Institution. The Annual Report is or will be in your hands and you will see the progress of work done in the year. We met in Bombay in 1922 and Sir Clement Hindley said then in summarizing the aims before the Institution "Let us have a definite campaign to secure 1,000 members." Seven years have passed and we have now about 1,200 members. It is our hope and wish that in the end every Engineer of standing in India will be a member, for his own good, for the good of the Institution and for the good of Engineering in India.

The reasons which influence the Bombay and Punjab Engineering Congresses to refuse to amalgamate with the Institution are somewhat obscure, but in particular the Punjab Congress has expressed its sympathy with the aims and objects of our Institution and has decided that a member of the Congress who is also a member of this Institution shall pay a reduced subscription. I sincerely hope that in time the Congresses will recognize the advantage of one Institution which does not represent any part of India, but has its Centres in all provinces.

The present Local Centre are as follows :-

The Institution of Engineers (India),
Bengal Centre—Headquarters at CALCUTTA.

The Institution of Engineers (India),
Bombay Centre—Headquarters at BOMBAY.

'I'he Institution of Engineers (India),
South India, Centre—Headquarters at MADRAS.

The Institution of Engineers (India),
United Provinces Centre—Headquarters at LUCKNOW.

The Institution of Engineers (India),
North West India Centre—Headquarters at DELHI.

What I want to impress on you is that these are not minor local centres, but the home of the Institution in the Province. There must be a headquarter to carry on the administration and that is in Calcutta, because it is almost the only place in India where you can always find a quorum of members of Council to carry on work, but it does not make Calcutta more important than any other home of the Institution.

Another point raised by Sir Clement Hindley on our visit to Bombay in 1922 was the question of permanent homes for the Institution.

I am glad to inform you that the Government of Bengal have sanctioned a 90 years lease of a suitable site on favourable terms in Calcutta for the permanent headquarters of the Institution and for the Calcutta Centre.

The Council has now in hand the task of the collection of the necessary funds.

As regards the other centres, the Local Governments have been or will be approached in connection with suitable plots of laud and the collection of funds will have to be left for the present to local enterprise.

It was in 1925 I last had the honour of addressing you and I then remarked how in 1913 I had started an Association of old Roorkee Engineers. One of the difficulties in running it was, as it is to some extent now, the difficulty of getting members to pay their subscriptions, even a modest one of Re. 1/-.

Now, this is a subject which is of great importance to the smoothness of running the machinery of the Institution and I regret to say that a great many members do not regard the prompt payment of subscriptions as an important matter. This necessitates great extra work and considerable expense in sending out repeated reminders. I want you all to bear in mind that the financial year of the Institution begins on September 1st and not on April 1st, and I would ask you all to take up as a matter of propaganda among your fellow members, the necessity for prompt payment of subscriptions.

In 1915 I went to the Great War and was surprised and pleased to find, on my return to India in 1921, that an Institution had been started on solid lines. Looking back on those critical few years of its early existence I cannot help thinking of the deep debt of gratitude we owe to those who bore the heat and burden of the day. To think of the troubles they had to shoulder, the difficulties of finance, the opposition and criticism they had to overcome and answer, is appalling. The size of India, Gentlemen, in itself makes the organization and administration of an Institution like ours a very difficult task.

I said in conclusion "This is your fifth birthday and may the wisdom and enthusiasm with which you in such a short time have turned the young child into a stout young man continue, till the grave and beneficent grey beard will be looked up to with feeling's of thankfulness and reverence not only by the Engineering professions but by a grateful India."

Well, Gentlemen, though perhaps the stalwart is now only beginning to have gray hairs there is no doubt he has grown greatly, and our greatest thanks are due to the Presidents, Councillors, and Office Bearers of the past.

I now only wish to say that I shall always follow your progress with intense interest and if there is anything I can do to help in any way I will always be at your command.

Mr C Addams Williams

C.I.E.

President 1930-31

Presidential Address

GENTLEMEN,

I wish to thank you for the great honour you have done me in electing me your President for the coming year, all honour I look upon as the greatest that can be conferred by one's brother engineers in this country. Since the day the Institution was inaugurated it has gone forward year by year gathering strength; though as yet our membership is not as high as I should like to see it, I believe, as the importance of the work it is doing becomes more and more known, our membership will steadily increase. The Institution has a great future before it and it is because we all have confidence in that future that we are shortly to become possessed of a headquarters building in Calcutta of our own, the Foundation Stone of which was laid to-day by His Excellency the Viceroy. Our confidence is shown by the fact that we have entered into a 90 years' lease of the land on which the building is being constructed. As membership increases we hope to open. more local centres and so bring members into closer touch and we look forward to the day when each local centre will have its own building. It is because of the increasing influence the Institution is exerting throughout the land and its future prospects that I feel very proud indeed of having been elected your President.

You have already gathered from the annual report the latest news concerning the Institution and I do not propose to cover that ground again. I propose to deal with a subject which affects us all and will affect us still more as time progresses; I refer to the strain which the speeding up of life has brought about on the human system, much of which could be avoided if a real attempt was made to do so.

One of the principal functions of this Institution is the dissemination of knowledge on engineering matters: in this respect it is doing good work; but far more than this is required. The engineers of one Province know little of what is going on in another. It might almost be said that the provincial boundaries constitute an impregnable barrier across which the news of the doings of engineers cannot penetrate. How often would a work be simplified in design and construction and reduced in cost, were we aware of the difficulties met with by others and how they were overcome: we should find many cases of failure of a particular method and should learn how best to tackle a problem at the outset, instead of working in tile dark and haying to resort to experiments. Except for visits which are arranged by the Institution, it is seldom that engineers visit works far from their own and access to scientific papers is difficult. Recently we have received valuable advice to keep abreast of the times: those of us who have been practising engineering for a quarter of a century or more can look back and take notice of the vast changes that have taken place in the world due to the progress of engineering science. It is not possible to keep up to date in all branches and still less is it so when we are out of touch with others. We have to deal with the laws of nature which are unalterable and the same the world over and never tell a lie; yet the most unnatural thing in this world is man. Nature never forgives a mistake and if we make mistakes, she will surely find us out. It is therefore necessary that we should study nature's laws as closely as possible.

These are days of specialisation and one of the most felt wants is the means by which knowledge on a particular subject can be quickly gathered. There should be some means of obtaining literature on the subject one is interested in: a central source of supply so to speak from which literature can be obtained at short notice. But not only this, a precis and proper indexing are also wanted so that time is not lost in searching for information specially required. The spare time of engineers is small and they cannot afford the time to search through enormous masses of papers: it is doubtless to a great extent due to the absence of easy means of reference that engineers do not study their subjects as deeply as they should and the result is that delays occur, the cost goes up and accidents happen.

It is therefore a matter of satisfaction that a Central Bureau of Information is being established at New Delhi by the Central Board of Irrigation for the collection and distribution of pabulum connected with problems with which the Irrigation Department is concerned. This is a step in the right direction. If properly conducted this Bureau will supply a long felt need; but similar steps should be taken to deal with other branches of engineering. I look forward to the day when there will be a Central Bureau administered by this Institution dealing with all branches of engineering and located at some central spot to which reference can be made by anyone requiring up to date information on a particular subject: the duty of those in charge of this Bureau will be to gather. I from the four corners of the earth all the useful details of engineering practice and compile them in a way in which they can be studied with the least amount of effort. With a properly conducted Bureau attached to it, the Institution will become the hub of engineering in this country. I think it would be a mistake for such a Bureau to be run as a Government concern. There are many engineers who are not Government engineers and there is no reason why they should not have access to the records. The Bureau should be administered by a sub-committee of the Council and have its own secretaries. The various Local Governments and the Government of India should subscribe towards its upkeep, since all Governments are directly interested in the maintenance and improvement of engineering standards and will benefit not only by more up to date practice but also financially.

However many years of our life we devote to a particular subject, we feel that there is more and more to learn and that should we live double the span of life allotted to us we should be cognisant of the feeling that we had still a great deal more to learn. Supposing therefore that we could in the first fifteen years of our professional life gain The same amount of knowledge we now acquire in the whole period of our active service, we should be in a position to take up and carry on the work done by others from the point where they had left it, much earlier in life. To do so it is necessary that knowledge already gained should be available in a concise form. Cannot we take a short cut to our object and cannot we start where others left off? To expedite matters by learning methods already employed with success should be our aim. What a lot of trouble and expense would be saved and how much strain it would relieve us of.

Looking at the administrative system as it stands to-day in Government departments, and possibly outside them, under which every officer is supposed to be able to retain in his brain a vast accumulation of rules and regulations, which are yearly added to or altered with great profusion, it is astonishing that the system has not broken down long ago. The time of the engineer is taken up to a large extent in dealing with matters of routine or accounts objections so that he cannot get down to the study of problems he wishes to and which requires a large amount of time. Most of us, I dare say, have experienced that feeling of irritation and annoyance when, having got deeply into the study of a particular problem, the whole of the work has had to be placed aside to deal with questions of routine which in reality should have been dealt with by others. Imagine an officer who has important works under construction in different portions of his charge, being glued to his office chair, when he should be getting about the work to see that everything was proceeding smoothly. The officers in charge are deprived of his advice and assistance when most required. When a man joins the engineering profession, he does so for the purpose of practising engineering and to my mind it is a great waste of human power and a most uneconomical method not to utilise his skill to the utmost. This overburden of work, brought about by an inefficient system, is another factor which prevents us from studying our problems fully. The establishment of Bureaus of Information alone will not solve the difficulty unless combined with a reorganisation of the system under which we work and until we are relieved of routine work to enable us to find time for the acquisition of knowledge. On what lines such reorganisation should be conducted is a matter of opinion, but I feel sure that any relief that could be given would be welcomed by all, and, possibly, the partial solution will be found in the separation of accounts from other work.

Our duty as Engineers is twofold. The works we build must not only stand up and perform the functions allocated to them: they must also be designed as economically as possible, remembering we are spending the money of others. When an accident occurs we are inclined to blame nature; but is it not a fact that we have made mistakes and have not fully taken nature's laws into account? A bridge is washed away, and we say the reason was that the flood was unprecedented, a word I personally do not like, and which is used much too frequently. What has actually happened is that our enquiries did not go far enough or our knowledge of the subject was too limited. It is up to us to see such accidents do not occur. Some years ago an eminent engineer said, "Do not be too cocksure of anything." His words have as much force to-day as when they were spoken a quarter of a century ago.

One thing we have to fight against is the tendency to get into a groove by not keeping abreast of the times. Let me give an example of what I refer to. 'We frequently see the question of the increase in noises ventilated in the press. Almost, if not everything we do, comprises the removal of some thing from one place to another, involving noises which are not wholly preventable. The strain in these days due to the speeding up of activities is far. greater on the human system than ever it was and nerves are becoming more and more highly strung. In the hustle and bustle of life people find it difficult to get complete rest even for a short time. Much of the stress is brought about by noise: are we keeping abreast of the times so long as we make little effort to ease the strain by reducing noise?

Is it not possible to design a lorry in such a way that it does not annoy everyone in the vicinity of its journey? Is it not possible to load that lorry so that its contents do not create a hideous din? Should not the owner of a lorry be heavily fined for plying the lorry with half a tyre missing? Is it really necessary that locomotives in a marshalling yard should proclaim their existence by long and frequent blasts? Was it really necessary that a certain driver should give a blast lasting live minutes because he was kept at the distant signal awaiting line dear and incidentally awaiting his Christmas dinner? Is it really necessary to stable wagons for miles on both sides of the main line during the slack season, thus Hot only shutting out the view, but preventing conversation and creating headaches and strain? Likewise could not something else be invented as a railway fence dose to a main line than one of corrugated iron? Is it not possible to remove roaring rails from a track? Should not noisy industries be removed from the vicinity of residential areas? Many other examples of unnecessary noise will occur to you.

I think you will agree with me that although in some instances, such as the surfacing of roads, action has been taken to reduce the annoyance arising from noises, much remains to be done and probably a great deal could be done by the exercise of a little forethought. Engineers are particularly bad in this respect and have yet to learn how to think of others and how to make a noise quietly.

Take the question of congestion of traffic in the large cities: is it not possible to do something to separate pedestrian traffic from vehicular traffic and to separate slow from fast traffic: on the Kidderpore bridge we have done the latter by placing the slow traffic roadways outside the girders: could not the danger of accidents be minimised at street crossings by the use of overhead escaladers ?

Another way in which strain can be eased is by placing a greater trust in the man on the spot by delegating more powers to him, so that the work is sifted out and the man at the top is not snowed under by petty matters. Surely one who has powers of spending many lakhs of rupees on works should be trusted to the extent of sanctioning the purchase of an umbrella for his orderly peon, or that involved in washing his pugree. I give these examples merely to show how ridiculous matters have become. Hundreds of similar examples could be given. But would .not a little relaxation lead to greater efficiency, less strain and diminished expenditure on staff?

In the matter of disputes between departments, is it not a fact that correspondence could often be much curtailed if the department which was in tile wrong accepted the position as soon as it had been convinced that such was the case, instead of continuing an acrimonious correspondence, possibly extending into several years? I have known an instance in which the dispute continued for no less than 16 years, though it was obvious from the beginning that one of the parties had really no case, and such was the decision eventually arrived at by both sides. In such cases t here should be a genuine desire to close the matter as early as possible instead of needlessly wasting time. Such disputes can often be settled by a conference as indeed the case I have mentioned was ultimately settled.

Gentlemen, I think I have said enough to show how the strain and stress of life affect ns in our daily work and how unnecessary much of it is. As time goes on the muddle intensifies and it looks as if the human system must break down sooner or later. There are many ways of tackling-the disease and so far as we engineers are concerned, we should see that we do not stand aloof but should set to to simplify life as much as is possible.

Raja Jwala Prasad

President 1931-32

Presidential Address

Gentlemen,

Feeling as I do that I am here amongst my brothers and friends my heart is averse to customary courtesy or fruitless formality of thanking yon for the great honour or apologising for my greater unfitness for the office you have so kindly asked me to fill. Suffice it to say that as a brother in profession you have called me to do some service and I on my part will do the best I can.

Still less have I any desire to take you through the dull drudgery of the financial and numerical figures of this Institution. These are regularly circulated and you have doubtless glanced and listlessly laid them aside.

Gentlemen, these arc the days of democracy and its root principle is that each demo or individual gives his entire strength to the whole. An illustrious predecessor of mine raised each Provincial Association to the Institution of Engineers in being. May I inspire you to realise and act that each one of you is the living embodiment of this Institution? Pray take this not as a figure of speech; given the necessary zeal, the necessary devotion, the necessary effort and a beneficent providence, there is no limit to human accomplishment. Love and devotion to the profession are the spirit, membership and subscriptions but follow.

An earlier predecessor and that an original founder stated on a similar occasion that this Institution was primarily meant for Indians. By this I think he did not mean an engineer in India but an Indian engineer. As I belong to this category it is but natural that my sentiments and opinions but follow the trend of the blood in my veins.

Gentlemen, we are meeting this time at the threshold of a year pregnant with potentialities. The atmophere is surcharged with a feeling of instability while an engineer is always at work to secure stability. When others agitate, engineers cogitate. They are nonetheless patriots but their work consists in material creation, ever beneficent, frequently economic, necessarily accurate and never irresponsible. This specification of their calling naturally developes special qualities that are appreciable assets in the service of Mother India. Modes of expression and action may differ but If the energies and thoughts of various groups converge on the single focus of patriotism, the future of a country must assuredly be bright. Though all must serve, each should serve where he can serve best.

Where then is the place of the Indian engineer in the present evolutionary stage of his country. Turn where one may, the entire length and breadth of India exhibit more extensively and intensively the work of combined constructive effort in this profession than in any other. This he has to take over and to supplement so as to keep himself abreast of other nations. I hold that this Institution of Engineers was founded to make us self-sufficient in the domain of engineering, to help this country to rise to its proper level in all that is visible; and to make its own contribution in the various branches of this beneficent profession. If this is correct the Indian engineers have before them a life of loving labour, earnest devotion, acute observation and searching research which will give their European confreres the supreme satisfaction that the results of their genius and labour will be in safe and sympathetic charge.

To achieve this consummation engineering education in all its branches should be recast on national lines under the advice and guidance of this premier institution. Young though it is, it represents and should represent all that is best in the profession in this country, and untrammelled by any other considerations than those of purely professional interest, it is undoubtedly the best agency to co-ordinate action, to fix standards and to accelerate engineering education in the various provinces of this vast country. We have Arts Universities in all provinces and in this province more than in any other. The engineering and other professional colleges have been fighting shy of amalgamation with them for fear of being swamped. May I suggest the formation of an all-India Engineering and Industrial University wherein all the engineering and industrial forces should co-operate in training the youth for the material and economical uplift of their country? Incompatible though this suggestion may be with provincial autonomy so much in the air, it is the only feasible proposal till such time as leach province has advance enough to possess an Engineering and Industrial University of Its own. We may be good irrigation, building or railway engineers but we are yet far behind in other important branches such as marine, agricultural, aerial, military, electrical and mechanical engineering. Adequate training in these branches is impossible without thorough workshop training which in its turn depends upon well equipped and varied works of manufacture. Hence the importance of industrial co-operation. Be it remembered that only about 40 years ago the whole of Upper and Central India used to be fed by a single Arts University. The railway engineering is already an all-India subject, industrial activities differ widely and separate provincial efforts are not likely to be efficient at present. In this scheme every province will specialize in the branch for which, owing to its surroundings, traditions and previous development, it is best fitted so that maximum of results may be achieved with the means now at our disposal. Time will later surely come when all the provinces will be self-sufficient to vie with each other in industrial and engineering education and research.

Looking at the present financial distress, the enormous mass of ill-kept human material, the immense culturable area and the vast geological and mineralogical resources, what can bring peace and prosperity better than an economical renaissance of India with cordial co-operation and mutual trust of the landlord and the, tiller, of capital and labour, of the practical engineer and the enterprising industrialist. The higher must live for the lower and the lower must love and serve the higher that lives for him. This is the principle of right that brings happiness, not the contest of rights that keeps people in perpetual perplexity.

That immense resources, both animate and inanimate, lie dormant none can deny, that when mobilized they must make a marked impression on the economical aspect of the world is as clear as daylight. The work before the Indian engineers is therefore huge and glorious. If they are in earnest to work for the Mother that gave them birth, they must have inspiration, imagination, reflection, proportion, indomitable will and incessant effort. No other class has such a magnificent and far-reaching mission before it; we should see that no other class excels them in sacrifice and love to achieve the same.

I hear an increasing whisper that mechanical engineering advancement is not consistent with the path of patriotism or the well-beingof men. Surely an all-wise Providence would not design a world in which the mind of man could not evolve with the manipulation of matter in the service of his kin. If a spiritual disquisition is permissible here and an entry into metaphysics not out of place, the human body itself must have been evolved after fervent desire, patient research and careful observation over ages, compared to which our best machines are but a poor specimen. The high place accorded to *kala koshal* or engineering ill ancient and golden India. of Ramraj is Illustrated by the exalted position accorded to Vishwa Karma in the Hindu Pantheon; by tho construction of the famous bridge over the sea at Cape Comorin and by the flying of Rama to Ajodhya in a single day after the conquest of Lanka to save his devoted brother Bharat, if not earlier still by the cutting of the Gangotri from a wonderful glacier through disinfecting rocks and land by his great ancestor Bhagirath, before men knew how to dig a well. Some people dismiss these ideas with a sneer but be it remembered that our ancestors had a great reputation both for imaginative construction and veracity, that the Romans, whose remarkable works still remain, acknowledge their kinship with Indian culture and that the diggings at Sarnath, Mahendo Jaro and other places cannot otherwise be accounted for. The *takli*, the spinning 'wheel, tile potter's wheel and the bullock wheel were in themselves the greatest engineering discoveries of their age and the modern machines are but a multiplication, an enlargement and an accentuation of till very principles illustrated in them.

It must, however, be acknowledged that machines are not an end in themselves. They are there to sene mankind and if their multiplication conflicts with the legitimate exercise of human muscles by masses of humanity or makes them helplessly dependent on irresponsible capital a halt must be called and a reorientation of outlook brought about. This country, however, is far behind such a, stage, the population has not even 1 per cent the comfort it should legitimately have and an application of the material resources to give them minimum standard of life is as religious a duty as any other.

Let us therefore resolve to do our best in our line, bring irrigation, power, knowledge and intelligent effort to the hovel of each cultivator so that he may raise more, earn more and use more than he does at present; build machines which we can economically build for the good of our people, prevent disease, danger, and discomfort, unearth precious material in our hills and mountains, work with our hands and think with our brains, conserve our wealth and diffuse our work, give up service considerations and render unselfish service and I hope and feel that in these efforts we shall receive cordial co-operation and sincere sympathy from our European friends whose predecessors founded this noble institution with the truest of patriotism for the country of their temporary adoption.

Gentlemen, some of you might like to know a little of my own experience in the profession. During the period of over 31 years of my professional career I was connected with irrigation, sanitation, architecture and generation of hydro-electric power. As an irrigation officer I served the Indian cultivator with the best of love; in sanitation I cleared the city of Patiala of dirty drains and disease and presented the citizens with a pure supply of chinking water, in architecture I served the Prince and the public in Patiala and the Benares University and did a little to rejuvenate the Hindu architecture to the tune of its musical soul and with the hydro-electric schemes of these provinces I aimed at promoting the agricultural and industrial interests of our people. Strenuous as these duties sometimes appeared to my friends, they were always a source of happiness and enjoyment to me till my long last devotion to the farmer transformed me into one. On the happy morn following my retirement I offer my warmest greetings to my younger friends and wish that they may enjoy their beneficent work and humble service as well as I and start on a new life with faith and hope in the service of the Mother.

Dr A Jardine
President 1932-33

Presidential Address

Gentlemen,

In addressing you for the first time as President I must thank you most sincerely tor the high honour you have done rue in electing me to preside over the Institution for the coming year. It is impossible to convey to you how much I appreciate this honour. I feel that it will be difficult to live up to the high traditions of my predecessors ill office, of whom I am delighted to observe that no less than three are present with us this morning, but I shall continue to do all in lily power to forward the interests of the Institution which we all have so much at heart.

Before dealing briefly with Institution and other affairs, I should record that I am very plea red to preside to-day over the first Annual Meeting to be held in Bangalore, which I am fully confident will be but a prelude to further important extensions of the scope of the Institution. I am sure that our activities in the South will now increase, that our Southern Membership will grow in strength, and that the South Indian Centre will also continue to take a prominent place as one of our chief Local Bodies.

I am, I regret to say, personally very poorly acquainted with South India. During the whole of my long service in India I have been resident in Calcutta, and while I have paid frequent visits to many other parts of the country I have seen but little of the South, I shall therefore take advantage of the present Meeting to make acquaintance with some of the important Engineering activities of South India, particularly those of Mysore. Many of these Works are of noteworthy magnitude, and rank high with corresponding works going forward in other pads of the Globe. In particular I think it safe to Ray that South India excels in the formulation and execution of Hydro-Electric Cum-Irrigation Schemes, that as regards Masonary Dams in general India is ill the forefront, and that in respect of Irrigation itself no other country can be compared with her.

The usual Annual Report has been circulated to all Members and from this can be seen the most important facts and figures of our last year's working. I think you will agree with me that we can consider this satisfactory, and conclude from the gradual increase in our Membership, which now stands higher than ever before—the total being 1278—that the Institution is fulfilling the purposes for which it was founded. For the first few years after we started it seemed an almost impossible dream that we should ever be a thousand strong. This figure has been far exceeded, and we now must set our faces towards the two thousand mark.

I propose to-day to make a few general remarks on the Industrial and Engineering progress of India, commenting briefly on the importance of a correct appreciation of the vital necessity of affording adequate support and encouragement to the endeavours of her citizens to develop her internal Trade, General Commerce, and Indigenous Industries.

All modern civilisation is based ultimately on the work of the Engineer, and without him every branch of the complex system of our present day life would soon cease to function. This is such a commonplace truth that it is apt to be overlooked. I repeat it to emphasise the fact that it is strongly applicable to India as she now exists, and when I say that the Engineer is the keystone of the arch, I refer to him in the general and collective sense, embracing all the multitudinous branches into which our Profession is subdivided.

India is of course predominantly an Agricultural country, but she is also advancing rapidly along the paths of Industrialism. This is a sign of healthy development. In a country so richly endowed with natural resources it is inevitable that she will as time goes on make more and more use of her own indigenous products, and convert them to her uses within her own borders.

India has now taken her place definitely as one of the chief Industrial countries of the world. This important fact is somewhat obscured by her immensity in other directions, for however great the numbers engaged in Industry may be, they are overshadowed by the vastness of the purely Agricultural population.

Both the Agricultural and the Industrial population however are dependent on the Engineer.

In a country such as this whose areas are so large, and whose inhabitants, though numbered by the hundreds of millions, are yet so scattered, it has been inevitable that development from the backward conditions of even a century ago should have taken place as a direct result of the activities of the Government itself, including of course those of the Governments of the various States. It is in the first instance to the credit of the Government that out of chaos it has produced and maintained a state of tranquility and confidence throughout the land. Without this, little development could have occurred, and the phenomenal increase of the population during the last century would not have taken place. The country, thus stabilised by Government, was naturally also largely dependent for its development on the various State Departments which came into being for the purpose.

I am to-day interested more particularly in the Engineering aspect of this development. Improved communications and Irrigation together have brought enormous areas of desert land into cultivation, and have also improved land already sparingly cultivated, while the population has automatically expanded into these areas. At the same time the periodic devastation of the land by famine has been eliminated, and in each of these advances the part of the Engineer has been basic.

In later years the expansion of the Railway System has been continuous, although even to-day the mileage in use is totally inadequate when compared with the enormous area and population of the country. Here again the Railways are under the direct or indirect control of the Government. The Ports of India have likewise expanded and modernised themselves under the administration of their Trustees or Commissioners also responsible to Government. New Ports have been made, and older ports further developed, to open up fresh country and to accommodate the increasing needs of the people.

Of all these State Services it may be said that they exist, and are maintained, in order that the people of the country may carry on their daily life and business, upon which ill the long run the existence of the country is dependent.

Viewed broadly the cost of these Public Services is simply a charge to be carried by the economic life of the country. While keeping these charges down to the minimum consistent with efficient working, a wise Government should do all in its power to develop the volume of its. Trade, Commerce and Industry.

As a country develops the standard of living of its inhabitants rises, the luxuries of yesterday becoming the necessities of to-day, and the satisfaction of these wants becomes the basis of its whole Industrial and Economic life. The higher the standard attained, the more important to the conn try becomes this industrial lite. Applying this principle to India in the most elementary way produces some stupendous figures, for if by improved methods of agriculture, and increased Industrial development the Government was able to bring about an average increase of spending power of only one rupee per head of population per annum, the resulting gain to the business of the country would be about 350 million rupees per annum! Surely such a figure is worth keeping in view !

In spite of the great progress so far made by India, it is a fact that she is only now on the threshhold of her development, and in this development the Engineer must continue to play an increasing ly important part.

In this connection an entirely erroneous view is commonly propounded that, by the development of the country's own internal resources, Industries, and manufactures, a diminution of its importing capacity will result. On the contrary, in these days when no country is self-sufficing, the greater its spending power becomes the more it will want to buy from abroad.

This process of development however is not a rapid one, and it was not until comparatively recent years that the importance to Government of assisting actively the development of Indian Industries was fully realised. In this short time great strides have been made. The institution of Protective Tariffs has been of much benefit to the development of Indian Industries, which it is hoped will in due course become self-supporting and be able themselves to compete in the wider markets of the world. This process has in fact already commenced, and manufactured as well as semi-manufactured articles of Indian origin are finding their way abroad.

Until this definite policy of fostering Indian Industries was instituted, it was almost impossible to compete with the imported article from countries of old established Industry, which in addition to their own Home Market found a further important outlet in the export of their highly developed products. And it is the very fact of being able to maintain a larger output which enables these countries to reduce their costs below the level of the younger Industrial country struggling to establish its own Industry and to secure even a modest share of its own potential home market.

To a large extent these conditions still obtain in India, but as time goes on an increasing use is being made of its own natural resources and labour.

When we talk of Industry in general we include all forms of manufacture, in which the degree of dependence on the Engineer varies largely. For instance in a Factory for the manufacture of cloth or other similar product, once the machinery is installed and tuned up, the role of the Engineer diminishes to a maintenance basis, as the technique of the production is distinctly of a non Engineering nature.

In many cases however the product is of a more technical nature, and as such is in constant need of skilled Engineering Staff, Under this heading comes such manufactures as say Machinery of all classes, Ship Building, Bridge Building, Structural Engineering, etc., etc. In every case however as soon as a part or process can be standardised It is put on a production basis with a reduction of operative skill required and a saving of cost.

Probably the most notable example of this Mass Production is the Automobile Industry,—not yet however established in India,—in which a very highly specialised and intricate Engineering product is made and assembled at a cost nothing short of amazing, when considered with the real value of the finished article.

Closely allied to the Engineering Industry as such is the Steel Industry. It would be a revelation to most people in India, including many of her Engineers, to visit the Works of the Tata Iron & Steel Co, at Jamshedpur, and to see at first hand this most wonderful plant for the production of Pig Iron, and Steel. I think in fact that if it were only possible a thorough inspection of this plant should be included in the education of all Engineers in India. It is an Industry of which India may well be proud, for few countries can boast of an individual plant of such outstanding merit both as regards capacity and up-to-date lay-out and equipment.

It is now possible to obtain practically the whole of the rolled mild steel necessary to manufacture the largest bridges or structures from steel made in India, by Indian labour, and from Indian raw materials.

The fact cannot be gainsaid that the possession of a well developed Engineering Industry is a valuable asset to the Government of any country.

From this fostering of Indian Industries, the Engineering Industry in India has certainly derived much benefit. and noticeable advances have been made ill recent years in the local manufacture of all classes of machinery and other Engineering products.

Probably the Engineering accomplishment which has the widest appeal to the mind of both Engineer and Layman, is the manufacture and erection of large bridges over deep water. The fascination lies no doubt ill the obvious difficulties to be overcome, the frequently spectacular methods adopted during construction, and the usually pleasing and imposing nature of the finished structure, not to mention the final triumph of the skill and foresight of the puny human being over the great natural difficulties in his path.

I am sure we all as Engineers feel a thrill of pride as we contemplate the completion of a large bridge, giving free and obstructed passage across some hitherto unsurmountable natural barrier,

The recent successful manufacture in India of large Railway Bridges, having spans up to 360 ft. is an accomplishment, which would have seemed until recently quite an impossibility, and on this account the thanks of the Industry concerned are due to the Government of India through the Railway Board, for the confidence shown in its ability to execute the work ill India. The more so, in that it is an undoubted fact that the quality of the finished Indian product is in no way inferior to the best which could have been imported,

I now look forward to the time when India will be able to export bridgework and similar products to other non-producing countries, and so obtain a share in a market at present closed to her. This is a matter which might also receive the sympathetic consideration of Government.

While still on the subject of Bridges, I might mention that great strides are being made with that very modern method of Construction-Heinforced Concrete. Larger and larger spans are being tackled, and at the present moment an arch bridge of 300 ft. span is nearing completion. Here again the medium of construction is entirely of local origin, both the cement and the reinforcing steel being made in India.

In general it can safely be said that there is no fear of deterioration in quality when production takes place in India, if an efficient system of Inspection is adopted.

An increasing proportion of local manufacture for Government, or for Semi-Government Bodies is now subject to inspection by the Indian Stores Dept., and the rigid control exercised by this Department maintains a very high standard of manufacture, which is not inferior, and in many cases definitely superior to, the corresponding imported product.

Here again the thanks of the local Industries of India are due to the Indian Stores Dept., which has constituted itself a Champion on behalf of the development of India's indigenous resources and Industries.

In the days before private Industry had developed to any extent, it was incumbent on the State to establish and carry out its own Works. The question of relative ultimate cost can hardly have arisen, as there was no alternative. Of recent years however conditions have changed entirely, and the somewhat anomalous position has often existed with Industry anxious and willing to compete for work, which must however still be done by the State, on the dubious principle that as State means are available already, it is of necessity economical to use them.

The position in this respect is improving steadily as the false economy of State competition with private enterprise is being more fully recognised.

The ultimate function of every Government is to govern the country, and not to burden its organisation with departments running frequently in favoured competition with the private industries and enterprises of the very people whose Trustee it is, and from whom it derives the necessary funds, by taxation direct and indirect, for the continuance of the very machinery of Government.

As an Engineer associated with commercial undertakings I am at times somewhat intrigued by the naive suggestion that there is something almost immoral in making a profit on a Government Contract. The true economics of the case as already mentioned are apt to be overlooked, as also the fact that the Government itself takes good care to dip its hand most liberally into such profits when they do exist, and that its own prosperity is based entirely on the prosperity of its citizens.

Returning again to the Institution, into whose Membership we welcome representatives of all the branches into which Engineering is now subdivided, it is interesting to note that 43% of our Members are employed by Government or other Public or Semi-Public Bodies, while 34% are engaged by private firms, or in other individual employment, the balance of 23% being made up of Students or Associates.

Taking India as a whole it is probable that a considerably larger percentage of her Engineers come under the first category. As time goes on however this ratio should diminish, for it is a sign of economic vitality that the second category should be on the increase.

It is now time, Gentlemen, that I brought these rather rambling reflections to a close. In so doing I desire to emphasise the great traditions and accomplishments which we have inherited from our Predecessors. These cannot fail to be an inspiration to us all that we may strive to add our own contributions, however humble, for the benefit of the world in general, and for India in particular.

We belong to that great Body of Engineers whose interests are centred solely in their Profession, and whose ranks embrace without distinction all Engineers without respect of Race, Class or Creed. I personally have always been proud to belong to our Profession, upon whose past achievements I look with the greatest wonder and appreciative admiration.

Finally, Gentlemen, I thank you once again for having made me your President during the coming year.

Sir Guthrie Russell, *Kt*
President 1933-34

Presidential Address

Gentlemen,

I am very sensible of the honour which the Members of the Institution of Engineers (India) have done me in inviting me to be their President during the current year. It is a distinction which I can hardly claim to deserve as an individual, for I have not been directly connected with constructional engineering work for a considerable time, and I speak rather on behalf of the great engineering organization which I am privileged to control, and which you have honoured, in honouring me.

I say engineering organization advisedly, for, if an advance in Transportation means an advance in Civilization, a generally accepted fact, a railway system is one of the most significant contributions which the engineer can make towards social progress, embracing as it does, his activities in the three important spheres of Civil, in the generally accepted sense, Mechanical and Electrical Engineering. When a nation's railways and other similar public utility services grow beyond a certain size, it is perhaps natural that their importance to the country in the realms of politics and finance tends to obscure their true functions; at any rate their importance in these directions may sometimes be exaggerated. But it should always be remembered that in the first instance, it is the engineer who is responsible for creating these great undertakings. Often he starts from very small beginnings with little thought of subsequent developments, which may transform a few hundred miles of track into a wide-flung system embracing and transforming many thousands of square miles of country. It is the labour and the skill which the Engineer brings to a solution of the problems of location, design and operation, which ultimately determines the extent to which his work contributes towards that social progress which it is his object to promote.

Before I pass to matters of the present and the future, we must pay a tribute to the past in remembering those Members whom we have lost since we met last. Foremost, I would mention Sir Francis J. E. Spring, an Honorary Life Member, who died in August last at the advanced age of 84 years. This great engineer started work in India as far back as 1870, and although he was first employed in the Irrigation Department, the bulk of his service was spent with the Railways. He will always be remembered for his association with Mr. James Bell in connection with many remarkable bridges which span the great rivers of India. When Railway construction started in India, Engineers were handicapped by an inadequate knowledge of the behaviour of Indian rivers in their meanderings across the alluvial plains. The great advances made in our powers to control and train these rivers is very largely due to these two great engineers. Sir Francis completed over 49 years' service in India; a fine record and a fine example. Among the other Members, who have passed from us are Mr. Alexander, the Chief Engineer of Messrs. Mawson Vernon Co., whose chief interest was the application of re-inforced concrete to conditions in this country, and Mr. D. N. Ball, Superintending Engineer to the Tata Power Company, who was a Life Member.

It is a more pleasant duty for me to call attention to those Members who have been honoured during the year by His Majesty the King Emperor, and the Government of India. Sir James Pitkeathly, one of our oldest Members, richly deserves the Knighthood which has been conferred upon him after many strenuous years spent in the service of India. Mr. A. J. King has received the Order of the British Empire; Rai Bahadur A. N. Nanda has been promoted to Dewan Bahadur, while the title of Rao Bahadur has been conferred upon Mr. G. Nagnrutnam Ayyar, honours all well deserved.

The scientist has often been adversely criticised for his ingenuity in devising new and more terrible methods of destruction, and the engineer is unfortunately not entirely blameless in this respect. In India, however, his activities, at any rate in recent times, have been, I am happy to say, confined in the main to social, industrial and economic advancement. When progress in these directions suffers a set-back, through the inability of nations to move forward on peaceful lines, the services of the engineer are sometimes at a discount: he is, in fact, regarded in some quarters as an expensive luxury, voicing an impracticable idealism, which the necessitous nature of the times can ill-afford. I do not think, however, that we need be too depressed by any such thoughts. I suggest rather that we should welcome these periods of quiescence when society has to adjust itself to new conditions, for they provide valuable breathing spaces in which we can take stock of our accumulation of technical knowledge and review the results of our former labours with a critical eye. In military parlance, we are given time to consolidate and strengthen our position before a further advance. At these times, an opportunity presents itself of ascertaining whether our works are indeed fulfilling the functions which we hoped and intended them to fulfil. There is perhaps not quite enough of this looking back of consolidating our position. The engineer is sometimes apt, on the completion of a work on which he has been engaged for a protracted period-hi the words of a former speaker before this Institution—"to wipe his forehead and look round for another job of work." That indeed is the right spirit and it is the spirit which has animated many engineers who have spent their lives in the scorched plains of India. Yet, in so far as all our undertakings must ultimately be judged by the efficiency with which they promote social progress, it is essential that a careful scrutiny should be made of their economic results, so that we can be sure that our expectations are indeed fulfilled, or in cases where they are not fulfilled, that methods and technique are overhauled so as to discover why and to what extent they have fallen short of our expectations.

A time like the present gives us this opportunity. In periods of economic prosperity, a spirit of optimism prevails. Each step in technique wins immediate applause, and each project completed and handed over to the community appears at once to bear fruit, in some cases far beyond the expectations of its creators. On the other hand, in times of economic stress and financial stringency, we are apt to hear criticisms that the large capital sums expended on these engineering works have been thrown away, and even the engineer himself, influenced by the pessimistic atmosphere, begins to wonder if there is not some truth in these assertions. The philosopher—and no engineer of much experience fails to cultivate a philosophic outlook—should not be over-elated in the first instance or unduly depressed in the second. He should rather welcome the lean years which provide an occasion for the efficacy of his works to be fully tested, and be thankful that circumstances will permit him to strengthen the ground won and seek out any weak spots in the organization of his forces which less trying times have left undetected.

I think you will realize how natural it is that my thoughts should dwell on this aspect of our work. It has, in fact, seldom been absent from my thoughts during the last few years. There is hardly any country in the world in which the railways, regarded as a "financial proposition," have not been fighting with their lacks to the wall. These railways, which the enterprise of the engineer have brought into being, have, through a combination of circumstances, been subjected to an almost intolerable strain, but, I think I can safely say and I feel sure anybody who is competent to pronounce judgment on the figures will agree that the railways of India have stood the test; and I use the past tense, for although we may not be yet out of the wood, there are distinct indications of daylight ahead. But our success in this struggle has only been possible through the exploitation of the breathing space to which I have referred. It is true that steps taken in connection with the rehabilitation of the railways after the War have continued to bear fruit. Radical changes in the interests of economic operation are Hot carried out in a clay, while years may elapse before the accrued benefits reach their maximum. The reorganization of our workshops; modernizing of our equipment, both mobile and stationery ; and the provision of improved traffic facilities during the post-war period, have helped us to withstand the strain. But we have not been idle during the subsequent depression. Projects of a remunerative nature, begun before the present economic storm struck us, have to a greater or less extent been completed, and although we have been unable to embark on new works of any great magnitude, our time has been usefully spent in an intensive search for further means to economy. A fuller standardization of equipment, economies in the use of fuel and in expenditure on consumable stores, more intensive use of locomotives and the abandonment of obsolete or uneconomical types of stock. In these and many other directions, our efforts have resulted in very substantial saying in almost every department of, operation. Latterly, we haw had the valuable assistance of an expert from England with the result that we are exploiting further methods which the railways in that country have found efficacious.

And this brings us to the question of Research which is in these days attracting so much attention. New methods of investigation are being applied in a great variety of commercial and industrial organizations including those under governmental control. I should, therefore, like to say a few words regarding Research in the railway sphere. The term has often been confined to investigations into such matters as the component parts of steel, or the relative value of different materials, but to-day scientific research has, or should have, a far wider application, especially in the case of public utilities, whose function is to provide the community with service at the lowest possible cost. A railway is an industrial and a commercial undertaking. It manufactures, or buys locomotives, wagons and a great quantity of miscellaneous material ; it operates and it sells transportation. It follows, therefore, that research from the point of view of a railway falls under three heads: that concerned with Technical and Engineering research; research regarding the best types of Organization; and Commercial research.

As regards the first, you will be familiar with many aspects of the work to be performed, the field for research is large but I shall confine myself to mentioning only one or two examples to illustrate the possibilities in this direction. Wind resistance to the movement of trains is a matter which has recently come under investigation, and it has been ascertained that an average six-coach train travelling in still air at 60 miles per hour absorbs as much as 283 horse-power. It is perhaps impossible to design the ideal train in view of the operating and commercial considerations involved, but it is probably possible to reduce the horse-power absorbed from 283 to 158; a substantial improvement which means a very considerable economy in fuel. Savings can be made by lengthening the life of signal and telegraph wires, while paint is another material, of which large quantities are used on the railways and in regard to which properly organized research should yield useful results.

Research into methods of organization is colloquially termed "job analysis." Within the last year, special units of organization have been set up on certain of our larger railways to examine in a systematic manner every activity and operation on the line in relation to man-power and material. These organizations are under the control of a special officer designated Deputy Agent "Organization." He is directly responsible to the Agent or General Manager of his Railway. This, somewhat novel form of research, is in reality only an extension of the principles adopted on the engineering side of railway working. Study is required, for instance, before the layout and progressing of work through workshops can be conducted with efficiency. The man-hours required for particular operations and the connection between the work of one machine and another has to be investigated in great detail. It is equally possible and desirable to "progress" work through an office as in a workshop. The great possibilities of this have been brought forcibly to notice by the special organizations I have referred to. I would make-a special appeal to any railway officers who may be present to hell' the "Organisation" Deputy Agents in every way in their power, because the more co-operation there is, the quicker will increased efficiency be obtained. Such research, or in fact, any research-presupposing as it does lengthy and detailed analysis-cannot be carried out by Administrative or Executive Officers in their stride; establishments do not include a margin for this purpose. Research of any kind requires standardized, organized and co-ordinated attack. This is the reason special organizations have been set up to handle this work, but if adequate results are to be obtained the co-operation of every member of the staff is essential. I should like specially to emphasise that the necessity for constant research and investigation should not be taken as casting reflections on the ability of, or indicating a lack of confidence in the officers and staff on Indian Railways. It is specialist work and must be carried out by specialists. I would make one further suggestion and that is the desirability of taking into your confidence the more lowly members of the staff when conducting all researches. I have seen experiments fail because the operators of the plant connected with the investigation have not had the object in view explained to them. On the G. I. P. Railway, a very excellent practice is in vogue of putting up ill the cabs of locomotives details of any special fittings on the engine with explanations as to their objects.'

The third aspect of research, which is concerned with the purely commercial activities of the railways is equally important, dealing as it does with revenue as contrasted with expenditure. The potentialities of certain sections of the line in regard to passenger or goods traffic; studies of the consumption of particular commodities in one area compared with that in another; investigations into local circumstances or customs in relation to existing railway facilities; these are some of the questions into which commercial research can usefully enquire.

Brief mention of the Research Organization which has been adopted by the London Midland & Scottish Railway in England may be of interest. On the Technical and Engineering side, they have a Research Manager who controls an organization consisting of Chemists with Engineering, Textile and Paint Technologists. In addition to this, they have a Scientific Research Committee meeting periodically on which eminent Scientists are invited to serve from time to time as subjects arise on which they are qualified to advise. In regard to organizational research, a special officer with suitable staff is continually devising means of measuring by exact methods the multifarious operations in different departments with a view to simplification and the elimination of useless or redundant effort. Lastly, on the commercial side, there is a special branch of the Chief Commercial Managers Department under the control of a Research Assistant, who carries out investigations into the economics of different industries, the potentialities of different districts and so on.

I have tried to indicate briefly the efforts which ate being made by railways to expose all their operations to the searchlight of scientific analysis, I feel certain that the methods which have been applied to railways aud which are already bearing fruit, are equally applicable to many other spheres of engineering and commercial activities.

I have, I think, dwelt at sufficient length on some of the problems which are of special significance in these days of depression, but though they have been brought before us with special force during the past few yean; it must be remembered that they are problems which can never be neglected even in time of prosperity. At all times "a penny saved is a penny earned," in tile case of a railway it may be two pennies earned as cheap transportation spells prosperity to a country.

I shall now turn to the problems which, so far as I see it, the future confronts us with.

The engineer in India is in some respects in a fortunate position compared with his confreres in more highly developed countries; for, although much has been done to alleviate the immediate and mote urgent necessities which unfavourable climatic conditions and a low standard of living impose, yet the scope for his further activities is almost limitless, India already possesses irrigation systems, which an larger than any of those in other parts of the world, yet opportunities for further expansion in this direction are by no means exhausted. The country has a railway system of which I hope and believe we may be justly proud, but there is no reason to th ink that we have reached it position when further trunk lines will not be necessary. I say trunk lines, because it, would appear from recent experience, which is not confined to India, that the advent of tile motorcar will lead to an unprecedented increase ill road mileage, which will to some extent take the place of branch-line railways. The plains of India are particularly suited to road construction, and there is little doubt that tile engineer will he engaged in building many thousands of miles in the decades which are immediately ahead. In a land where much of the fuel used for industrial purposes has to be carried many hundreds of miles from the source of supply to the point of consumption, the exploitation of the hydro-electric potentialities, which exist in many Provinces, opens up a wide vista. But the sphere of engineering which perhaps gives promise of greatest development is that of the townplanner and the water and sanitary engineer. Here indeed we have what is practically a virgin field, for the work which has already been accomplished in the larger towns only accentuates the need in more backward areas.

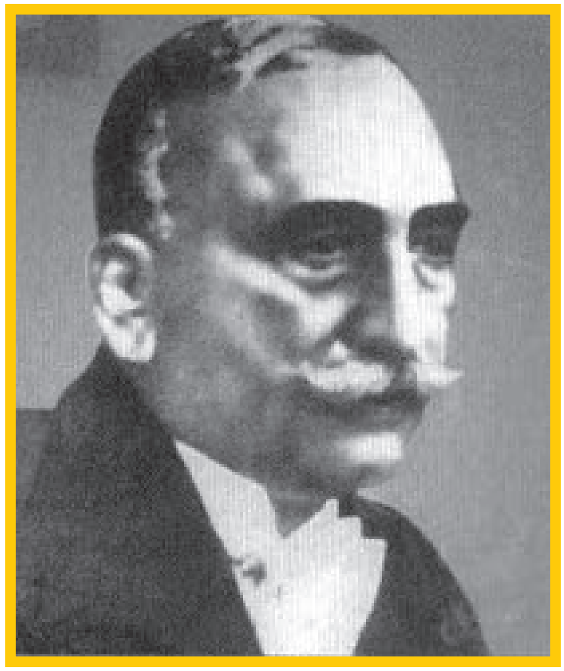
There is another way in which this country is fortunately situated. In Europe and in America, during the last hundred years, much new ground has been broken, while technique in almost every aspect of engineering practice has been revolutionized. It has often happened that in these countries new methods have had to be tried out with little or no previous experience. In India, on the other hand, there is now little need tor us to embark on large projects, the results of which cannot be foreseen with reasonable accuracy. A vast amount of experience has been accumulating in other parts of the world, and it is only necessary that this experience should be drawn upon by the engineer in India. Conditions of course vary. In many cases methods which are applicable in the West are not suitable in this country, either on account of the peculiar climatic conditions or because social or industrial organization has not reached that point when the methods of more highly organized communities become practicable. At the same time, no feeling of national self-sufficiency should deter the Indian engineer from profiting by other peoples' experiments and other peoples mistakes. This Institution of Engineers can do useful work by collecting data and co-ordinating effort, but nothing can take the place of deputations and visits to other countries to study methods which have there been found successful and the works in which these methods have been applied. The Indian engineer should, in fact, regard these as an essential part of his technical education.

In every direction, therefore, the engineer in India can look forward to a long period of useful work. Most of that work will be carried out by Indians, and I think It is particularly desirable that no Indian engineer should fail to become a member of this Institution. Its inception and the vigorous growth it has displayed during the last few years is due to the joint efforts of the European engineer in India and the Indian engineer. The Institution has before it, I feel sure, a long and useful life, but its usefulness will depend very much upon the way in which it is supported by the engineering profession in this country. The country is large; the number of working engineers is already greet, and will increase as time goes on. Now that the position of the Institution has been firmly established and it has been provided with a permanent home, the Council has been going into its finances with a view to a reduction in the rates of subscription. The results of this investigation are, I understand, encouraging, and It is hoped that it will be possible to take action in this direction before very long. There will then be little excuse for even young engineers to abstain from membership, and I see no reason to doubt that with the whole-hearted co-operation of this large body of professional men, the Institution should not fulfil those beneficient functions which have given similar technical bodies in other countries such authoritative standing.

Although, as I have said, we have not recently been able to put our hand to any new enterprise of great moment — and I think this applied to other branches of engineering besides railways — yet one work of considerable importance and engineering interest has been completed within the last few months. I refer to the new harbour at Vizagapatam, which was opened by HisExcellency the Viceroy in December of last year. This project which is the outcome of half a century of thought and planning, and of many years of actual constructive effort, has at least been brought to fruition. A commodious harbour has been provided on the east coast of this great peninsula which will serve an area greatly in need of lip to date export and import facilities. At the conclusion of his speech, His Excellency laid stress upon the ultimate benefits which might he expected to accrue from the construction of the new port, quite apart from its influence in the immediate future. It is, I suggest, on this aspect of his work that the engineer may dwell in time such as these, and if I may, I will quote His Excellency's words.

> "The foundations of a great port with its entourage of commercial activities have been well and truly laid, Yet it is not on these beginnings, or the expansion of the next few decades, that I would dwell. Let us rather look to at time when other generations will be able to reap the full benefit of such vision and forethought as we have been able to exercise. We here present shall not see those days, but we may derive satisfaction from the thought that those who come after us may look back upon what will seem to them insignificant origins, with the realization that we builded not for the needs of the day but for the requirements of the great industrial nation of the future."

I cannot close on a more appropriate note, If the work of our hands is good, its influence will not be destroyed by periods of depression such as that through which we are now passing. That influence will still be felt, not only when the present winter of our discontent has given place to brighter times, but in the distant future when these temporary vicissitudes will have been forgotten.



Rai Bahadur B P Varma
President 1934-35

Presidential Address

Gentlemen,

I am fully conscious of the honour which the members of the Institution of Engineers (India) have done me by electing me as their President for the coming year. Not having been directly in touch with actual engineering for the last live years except on the recruiting side, the membership of this Institution has been my only link with the general profession. I can, therefore, hardly claim to deserve such an honour, which I regard as the greatest that can be conferred by one's brother engineers in this or any other country. Gentlemen, I thank you most sincerely for this honour.

I joined the Punjab Irrigation in 1898 when the practical side of canal hydraulics was in its infancy. While surveying or going about my works in the jungles of the Punjab, I could have hardly dreamt of the rapid and substantial advances which the science of engineering, in its various branches including Irrigation, has actually made during this interval of thirty-six year. I often used to come across difficulties and had recourse to crude devices to get over them. Being situated in remote comers of the Province any help by way of advice or consultation with senior engineers on such occasions was out of the question. It was on such occasions that the idea of an association where engineers could meet for an exchange of views or for rendering advice to the younger members of the profession, used to come to my mind. However, situated as I was, the ideal only grew with my helplessness till 1905 when through the help of some senior members it materialised in the shape of "'The Engineers' Association, Punjab." The Punjab Engineering Congress followed it six years later in 1911, and while the former served a very useful purpose as a pioneer, the Congress has during the last twenty-four years of its life done solid work for the good of the Province. The inauguration of this Institution in 1921 was the fulfilment. in the true sense, of my early hopes and desires. The Institution, gentlemen, though a comparatively young body, has already achieved a great deal, and I have no doubt that greater achievements await it in the future.

The earlier history of the engineering profession is enshrouded in mystery and dates back to the hoary past or the advent of the human race on the surface of this planet. The progress of human civilisation synchronises with the advances made in the science of engineering. The relics of bygone ages proclaim this fact and it is difficult to say whether even better performances by the engineers of the past have not been lost to us through the destructive agency of natural forces or human invaders, just as some of "The Seven Wonders of the Old World" seem to have disappeared. The relics of a very old civilisation, those at Mohenjodaro in Sind, were unearthed not very long ago. They are said to be the oldest so far discovered in India; and those who have examined the ruins carefully, declare that it must have been an up-to-date and magnificent town of its day. Whatever the town may have been like, one thing is certain, gentlemen, viz. that its builders had provided it with an efficient drainage system, both surface and underground. The grandeur of its houses, walls, baths and gates can be realised only insufficiently at present from their size, decorations and other small remnants found in the ruins, but the system of drains has not been so badly damaged and can be seen and appreciated. Those who have studied it closely and carefully tell me that it is as good as, if not better than, that of any newly laid out modern town. Gentlemen, I consider this as high praise for the ancient town planners and builders of Mohenjodaro. Being the followers of that illustrious crowd, we should feel proud to belong to their profession and, at the same time, be able to boast of having this Institution to look after and safeguard our infersets, which perhaps the engineers of Mohenjodaro did not have. Gentlemen, we ought to be doubly proud that we have to-day gathered under the roof of our "mother institution" in this country, embracing as she does all those who practise engineering or could call themselves members of thait profession.

'The work of a large number of engineers lies in remote and distant corners of this large country, and they have to carry it out not only under varying conditions of climate and temperature but also under certain local difficulties peculiar to the place. If I may say so, gentlemen, the ravages caused by the great Earthquake of January 1934 in certain parts of your own and the adjoining province of Bihar and Orissa, will occur to you as furnishing examples of peculiar and local difficulties. Engineers, and may-be several of our members, have taken and are still taking a prominent part in repairing the damage done; but I would be departing from my own subject if I proceed further to enlighten you on some of their difficulties met with in the discharge of their duties. I, however, trust that my friend Colonel Temple, the Relief Engineer and Supply Officer of the Bihar and Orissa Government, who has had first-hand knowledge of the conditions of the tract, would tell us something of his experiences on some suitable occasion. Whenever he does so, I am sure they will prove both very interesting and instructive. To return to my subject, gentlemen, when similar problems are met and faced at two different places, requiring different treatment and handling, a free and frank discussion of their merits cannot but whet our wits and infuse zeal and enthusiasm into our efforts for further investigations. By providing means for discussing and exchanging views on such problems, we not only enhance our knowledge but call upon the capacity and talents of those engaged in such discussions to make further efforts to discover the truth about the hidden laws of nature and to understand them. When the disease has been correctly diagnosed, the problem of its cure becomes easy. Whatever branch of engineering we may turn our attention to, a closer study of these laws becomes more and more desirable, because as the science progresses, its conflict with nature becomes more and more acute, and if a mistake is made, nature is sure to find us out and punish us. For this reason, the engineers of not very long ago (say 40 years back) were rightly advised to proceed cautiously while trying to harness the forces of nature for the service of man. The engineers of the present day can go forward more rapidly and confidently if literature dealing with the past experience and knowledge of those who worked in the same or similar fields before them, is available for their use. This knowledge and experience is not only of great help to them but will save lot of time, trouble and money of all concerned.

In the old days engineers used to come and go and carry their experience and knowledge of Indian problems with them to countries and places where it was of little use. Usually, the major portion of it was lost for ever, though a small fraction was perhaps preserved in books or pamphlets published in countries other than India. This record, therefore, was not readily accessible or of much value to engineers working in this country. The establishment of this Institution has provided a suitable repository and a sure means of disseminating such knowledge. The Institution has not failed to recognise this as one of its foremost functions, but, as far as I know, not on any organised lines. The only good and useful model for this sort of work that I know of is the Central Board of Irrigation and its Information Bureau. It, however, concerns itself only with Irrigation problems, and it will be readily admitted that one board, however well-equipped it may be cannot meet the general requirements of every branch of the engineering profession. Separate boards are required and will have to be set up for Sanitary, Mechanical, Electrical and other branches of the profession to overcome this difficulty. In other countries, like England and America, different branches of engineering are represented by associations and societies of their own, Unlike them, our Institution comprises all the branches of the profession over the whole of India. This, gentlemen, is a glganatic undertaking and, though quite worthy of this robust and young society, it needs a well thought out plan for the development of its several branches side by side. I am quite hopeful that with the assistance of our members spread all over the country we shall in a short time be able to collect and disseminate a vast store of knowledge and information about engineering and its present-day practices suited to the peculiar conditions and needs of this country. I also think, and it will be readily admitted, that, unlike other countries, the conditions under which engineering works are undertaken, designed or but it change from province to province in this country, and require particular treatment and handling; and for this reason also the collection of a variety of experience has become a necessity for the profession.

For all these reasons I wish and would recommend that a bureau be formed and administered by this Institution, dealing separately with all its branches. It may not be possible to make a start on a comprehensive scale dealing with all the branches, but we may begin with as many as can be tackled at present, adding on others and sub-dividing all or any of them as necessity arises or experience demands, I would suggest the names of the following branches of engineering with a central office at Calcutta and branches at suitable local centres for a beginning:-

1. Civil Engineering.
2. Electrical Engineering.
3. Structural and Architectural Engineering.
4. Sanitary Engineer-ing,
5. Mechanical Engineering.
6. Metallurgical Engineering.
7. Industrial including Technological and Chemical Engineering.

Engineers, as a rule, are generous in imparting their own experience and knowledge to others, and I therefore feel quite confident that our own members, and other eminent engineers not as yet within our fold, would help our Institution in this undertaking. It is one of the primary du ties of the Institution to see that young engineers receive a sound theoretical and practical training and that a high standard of education is maintained by engineering schools and colleges in India. There are a number of these institutions, some old and others comparatively new, imparting education in certain branches of engineering. In the last century when the profession of engineering was not much in favour with Indians and the number of colleges was also small, Government Services used to absorb nearly the whole of their output and any surplus, if left, used to find employment in industries and trades. In the present century, engineering schools and colleges have increased — in fact, each Province can claim at least one to itself, if not more — and consequently the number of engineering students and graduates lias been increasing from year to year, so much so that it has become impossible to find employment for them in the services under the Government of the country. Undoubtedly, trades and industries have also been developing side by side and ought to have absorbed a large number of young engineers for work and training, but unfortunately, on account of financial stringency and trade depression, this has, not been possible. The engineering schools and colleges of India should therefore try to keep abreast of the present-day requirements of the trades and industries of the country. Their technical courses should be moulded as far as possible in accordance with those requirements and their practical training should also follow suit. More importance should be attached to specialisation, because without that it would be difficult for students to find employment in trade or industry. In short, the students should be prepared as much for employment in trades and industries as under Government, and the training imparted should be of a nature to befit them practically for some special class of work.

In Government service there is no doubt the advantage that the candidate is given some training in the special class of work which he will be required to do during his service; whereas trades and industries require trained hands. It is also somewhat unfortunate that the right kind of training in several branches of the profession is difficult to obtain in India. In cases where it cannot be obtained in India, the student should be advised by his college authorities to visit some foreign country where it may be obtainable. When such advice is given, I trust that due regard will be paid to the conditions prevailing in this country in regard to the particular branch of tile profession or industry in which the student desires to be trained..

The outlook of the student of engineering has necessarily to be quite different from that of others, and it is the duty of our schools and colleges to widen it by bringing their students face to face with nature, by increasing their powers of observation, and building up their character by teaching self- reliance, honest work and devotion to duty.

I have no doubt that the engineering colleges and schools can look after themselves in this respect, but I would like them further to realise that every step forward nowadays means more acute struggle with nature. The signs of the times show that importance must be attached to specialisation after a proper theoretical course and practical training. A smattering of education in all or some of the branches of the profession will not prove of much help to the students. In fact, it would have been preferable if some of the engineering colleges had specialised in only ope or two branches of the science of engineering and not sacrificed efficiency to comprehensiveness. Practical training is as much necessary as theoretical, and the colleges will have to combine with their theory and practice the development of character in their students, so necessary for an engineer in his after life. As the colleges belong to different provinces, their outlook is naturally, more or less, provincial, and thus some of them may find it difficult to recast their courses of education and practical training on the lines suggested. Hence, I think that this work should better be done under the advice and guidance of this Institution and in conformity with the peculiar requirements, if any, of the provinces concerned. The Institution represents the profession in India and should be able to accomplish this task untrammelled by any considerations other than those of purely professional interests and the necessity of improving and accelerating the education of engineers in this country.

The fact that the schools and colleges belong to different provinces ought not to prove a bar or obstacle in the way of this work, as it is not proposed to do anything against provincial interests. The teaching institutions will all remain provincial assets as at present, but the outlook of their education and training will be improved in such a way that it will not be confined to the provinces but will cover the interests of the whole country and of the profession in general. In other words, the colleges should be able to supply suitable hands properly educated and trained for the Services and for other engineering work in their own province, and at the same time be able to supply suitable engineers for the all-India Services and for other private or public industrial or commercial work in other provinces of this country.

Our Institution acts as the Indian Committee of the British Standards Institution, and had to consider and review nearly 200 draft specifications during the last twelve months as compared with ten in the previous year. This enormous volume of work was tackled in a businesslike manner notwithstanding certain difficulties which need not be detailed here. In their comments on all the draft specifications the Institution paid special consideration to their suitability to Indian conditions and requirements, both from the manufacturers' and the users' points of view. I trust this would be considered a very commendable piece of useful work done by the Institution, and hope that it will continue exercising the necessary checks in this direction, to the best advantage of the manufacturers of engineering materials in this country.

Those of our young men who have recently joined the profession should not lose heart because due to financial stringency the future outlook is not quite bright and the conditions as regards employment in Government Service, trades or industries more difficult than before. I am sure these conditions are not I going to stay with us for ever. Our country has enormous resources, such as large culturable areas, vast geological and mineral deposits, and sure chances of obtaining cheap power. These resources, if properly utilised and developed, should have a marked and healthy effect on the economic aspect of the country and its inhabitants. In any profession progress requires patient, persistent and repeated efforts, and every step forward has to be thought out, as proceeding in a hurry would be courting failure. Bearing this in mind, I think the work before our engineers is not only huge but such as promises a glorious field for their activities, if they only apply themselves to it sincerely, with courage and an indomitable will. Tell me of any other profession with much magnificent and attractive prospects before it.

For the class of development work mentioned above engineers with imagination, self-confidence and character will be required, but they alone will not suffice, and nothing will be done till they join hands with a body of industrialists well qualified and trained in their own lines. This combination of capital, intelligence and labour should result in an addition to the productive capacity of the country and its output of manufactured articles, and thus inaugurate an era of economic prosperity. This plan has been tried and has proved successful in other countries with much limited resources as compared to our own, and I do not see why similar results should not follow our efforts in this country.

As the times are unpropitious and hard, I would ask the young members of the profession not to be apathetic or indifferent, nor have undesirable jealousies with other members of the profession, as that is likely to retard progress. As members of the Institution we should be ever ready, within possible limits, to give a helping hand to our professional brothers, whoever and wherever they may be.

Col F C Temple

C.I.E.

President 1935-36

Presidential Address

Gentlemen,

The position in which you have now placed me is in my opinion the highest honour that can be bestowed in India on one Engineer by his fellow Engineers. I deeply appreciate it and I feel that it is the more to be valued and appreciated because it is bestowed on me by my Associates and not by outside authority. That I should have been chosen. for this position for what may very likely be my last year in India is a great gratification to me and I tender my sincere thanks to the Council for electing me.

My immediate predecessor has the satisfaction that his year of office has seen the culmination of the great and sustained effort which has built up the Institution in such a way and its credit to such an eminence that it has been granted a Royal Charter. It will be the primary duty of my year of office to see that the effort is not relaxed. Many of my predecessors have spoken of the responsibilities attached to the Presidentship. Now that the Institution has received its Royal Charter the responsibility devolving on the President and Council in particular, and on the members of the Institution in general, is greater than ever. The responsibility formerly was to the Institution alone. Now, the responsibility is also to the power which granted the Charter. The members acting through their President and Council are now trustees of the confidence reposed in them. It is their duty to see that that confidence is fully justified, by maintaining the standard of the Institution at its present high level, and, as it seems to be inherent in human affairs that they cannot proceed at one level but must go up or down, by steadily raising that standard and never allowing it to deteriorate.

Maintenance of a standard by the Institution involves the necessity for a certain standard of attainment in their profession by all its members, involving both general and specialised training. The frequency of the references to training made by my predecessors in this Chair in their Presidential Addresses shows what a prominent place the consideration of training has held in the minds of those who have been responsible for guiding the development of the Institution. To discuss training at length is to tread on dangerous ground and to invite criticism, for training is a controversial subject. Nevertheless it is a subject on which I feel so deeply that I propose to take the risk and state my views, submitting as my justification for such a venture that all my early life was spent in an educational atmosphere among people whose business was education and that I have never entirely lost touch with it; that for seven years I was President of the Committee which managed all the educational establishments in a town of over 80,000 people, that for many years I was on the Governing Body of the Bihar Engineering College, and more important than any of these, that for some twenty years I had under me for their year of training after passing their College Examinations one or more engineering students. It interested me to spend a good deal of time with them: watching them: seeing what characteristics had been developed and what neglected by the different Schools and Colleges, and finding how best to guide them so that they should attain their fullest development. Incidentally I have been amply repaid for any trouble taken because so many of them have become capable assistants that it was a pleasure and satisfaction to employ.

A former President pointed out that the outlook of the student of Engineering has necessarily to be quite different from that of others and that it is the duty of our Schools and Colleges to widen it by bringing their students face to face with nature, by increasing their powers of observation, and building up their character by teaching self-reliance, honest work and devotion to duty and went on to say "I have no doubt that the Engineering Colleges and Schools can look after themselves in this respect." In my opinion the Colleges and Schools need constant support and encourgement if they are to look after themselves in this respect. Two forces are perpetually acting against them one is the tendency to earlier and earlier specialisation, which is steadily tending to the substitution of mere instruction for real education: the other is the temperament of the students which is liable to look on book learning as an end in itself and fails to connect it with reality.

But, training does not begin with the Colleges and Schools. It is true of all professions and particularly true of Engineers that training begins in babyhood, when the first lines on which character will develop are laid down, and, for the Engineer at any rate, must go on as long as he is actively useful, for the Engineer who ceases to learn becomes a back number. My experience is that people tend to forget the importance of the early years, and are inclined to say that they are not their business. To such an extent however do I consider that they are the business of everyone interested in education in general and in Engineering education in particular that I propose to review the whole of an Engineer's training from the start.

It should begin in the same way as every other real training should begin. It should aim at developing the individual to as great an all round perfection as possible, capable of responding to every call, and of rising to every emergency. Such perfection can only be achieved by the training of body, intellect, and character, and must begin from the cradle. As it is the foundation on which all specialist training is built, it does not require a very early decision in favour of a particular profession. Specialisation should always be postponed as long as possible.

In the training of the very young child there are two points of supreme importance: the inculcation of the habits, first of implicit obedience to proper authority, and second of concentrated attention on whatever matter is in hand. If these two are taught during the first four years of life, the child is well equipped for learning anything and everything. If they are not, the home training which is the foundation on which the School has to build is liable to be a poor and inadequate foundation.

From the time when the child first learns to read until at least the age of fifteen, the development of body, intellect and character should proceed on as broad lines as possible.

The full development of the body is of greater importance to the average Engineer than to men in many other professions, for he is likely at some time or another to have to endure exposure to severe climatic conditions, and may even find it a great convenience to be able to exert his utmost physical strength, and it is certain that if he has good health and does not have to expend mental energy in caring for his body, he will be able to do his work better.

The development of character is very necessary to the Engineer because he may have to make quick decisions of far reaching importance. He must have confidence in himself and be able to inspire confidence in others. The beginning of the training of character is the habit already mentioned of implicit obedience to authority. That is the foundation of all discipline, and the basis of self-control. The Engineer is often called upon to take a lead, and a leader of men needs above all self-control. The firmer grip a man has on himself, the firmer a grip will he be able to take on all those with whom he is associated.

He should also possess initiative. For this he must have self-reliance. In developing these attributes the training of body and character moves together, and there are few better methods of developing self-control, discipline, initiative and leadership than playing in team games, or scouting. The former encourage observation and quick decisions: the latter, observation, memory and logical deduction — all valuable aids to the development of the intellect. Different games have different values in developing character. Some such as Racquets and Tennis make the player quick off the mark. Golf develops concentration of attention. Cricket develops that and alertness. Football and Hockey develop the team spirit and teach co-operation.

Above all it is necessary that the Engineer should be able to express himself so that his words whether spoken or written will convey to others precisely what is in his own mind. For this the best training is some form of literary education; preferably the study of languages. Of all languages Latin gives the best training to the mind in precise expression and probably French next.

Concurrently with all these, elementary mathematics and elementary science should be taught; but unless the boy shows special aptitude for them it is not important to carry them beyond the elementary stages because a mind fully developed otherwise will assimilate them with far less expenditure of energy than an untrained mind. A specially useful form of school training is the application of elementary mathematics, mechanics, physics and the like to everyday problems and as a general rule the more that instruction in such things resembles a game, the more likely is the knowledge imparted to become an integral part of the students mind. Above all at this stage pupils can be taught to use their eyes, and to think in terms of concrete objects instead of abstractions.

All this really applies with but little modification to the most useful form of education for all walks in life. It is on this foundation that specific Engineering training should commence.

To pass examinations the student will have to make some further progress in mathematics, but while it is a great convenience to an Engineer to be able to use them, it is easy to overrate their importance. Higher mathematics are waste of time to anyone who has no natural ability for them. Mathematics moreover are very cheap, and anybody who requires calculations made, can always have them done at a comparatively small cost. The teaching of applied mathematics in the form of Mechanics, Dynamics, Statics and Hydraulics and Hydro-Dynamics should all be based on practical illustrations, because it is supremely important that the Engineer should instinctively and almost sub-consciously apply his knowledge to what he sees in front of him or will see when he has carried-out into reality whatever he is designing.

The elements of drawing both freehand and instrumental should have been taught in the early years so that the pupil will have the necessary manual dexterity and be able to make a neat drawing, always remembering that a neat drawing is probably an accurate drawing. A clumsy or untidy drawing is almost certain to be inaccurate. Engineering drawing should be taught first from a model. The pupil should be given a model or still better a real machine and told to take it to pieces and make a dimentioned drawing of every part and then make drawings of the machine, as a whole, from several points of view. It is only in this way that a young Engineer can betaught to visualise what he is designing and it is onjy if he visualises what he is designing that he can be relied upon to design something which can be made. It is also only in this way that he can be taught to think on paper of things in their actual finished sizes.

About the age of 18 or 19 the young engineer can decide on the particular branch in which he proposes to specialise and then undertake an intensive study of the theory of that subject; but all the time should be continuing his general education.

We are concerned with results but that does not mean that we have no concern with the methods by which those results are achieved. Our influence on education throughout the country must steadily increase. The recognition that we have sought, and now received in our Charter, as the leading engineering body in India, will mean that the Engineering Schools and Colleges will come to look up to our Diploma as the goal, the attainment of which above all others, must be the object of their students. The primary schools will be cornpelled to give their pupils the foundations of knowledge and character on which the Engineering Schools and Colleges can build and so the Institution as long as it proves true to its trust will be a steadily increasing influence for good in the education of the country.

Rai Bahadur Chuttan Lal

President 1936-37

Presidential Address

Gentlemen.

I am fully sensible of the honour which the Institution of Engineers (India) has done me by electing me its President for the current year. It has been observed by more than one of my predecessors that this is the highest honour which it is in the power of the Institution to confer on one of its members, and for thus honouring me, my sincere thanks are due to all its members.

2. Before I proceed further we must pay our tribute to the memory of the late Sir Rajendra Nath Mookerjee, who was one of the founders of the Institution. Born in 1854 he died at the age of 82 full of honours and a shining example of what an engineer can do in the sphere of business.

3. Gentlemen, I began my career as an engineer more than 32 years ago and my lot was cast in what is known as the B. & R. Branch of the Public Works Department. I believe that the public are so accustomed to flee buildings and road around them, that the work done by an engineer responsible for their construction is not always appreciated. His work is not directly remunerative. It may be true that the roads constructed by him are an asset to the nation. They make rural life more attractive and tend to stabilise a healthy ratio of rural and urban population. They increase the social and recreational possibilities of both city and rural residence; they increase the flexibility and strength of general transportation system of the country, in times of stress, such as war and famine and they raise rural values. These are all indirect benefits, for which it is impossible to put an exact money value. A Building and Road engineer has, therefore, no direct profits or dividends to show and his work does not appeal to

our imagination, as that of a Railway or an Irrigation engineer, when we look at the development of railways or canals and their contribution towards the revenues of the State, or the work of a Mechanical Engineer when we look at the countless mechanical appliances in times of peace and war. The work of these engineers is considered to be of a specialized nature; not so that of a Building and Road engineer for it is contended that buildings and roads have been known to exist in all countries, from very ancient times and even to this day, are constructed by men without any technical training. We must admit that we have had "master builders" in the past but on close examination, it will also be admitted that the store of centuries of accumulated knowledge possessed by them, was more of the nature of rule of thumb and traditional practice. The distinctive feature of the present age, on the contrary, is to seek an explanation of the empirical knowledge, to amplify it and if need be, to modify it, by a study of the first principles, by research and investigation into the properties of materials and methods of construction. These researches lead to the discovery of new materials and new methods of construction to meet the varied and complex requirements of modern times. Practice, as far as possible, is made to conform with theory and until research discloses fundamentals, our knowledge remains empirical.

4. To-day I propose to speak on such research work as is of interest to a Building and Road engineer and when I speak of this, I should not be understood to mean research in the laboratory only but also of experimental work done on buildings and roads and materials, outside the laboratory. The latter is not of less importance than the scientific work done in the laboratories. Nor do I refer to research carried out in any particular country. We have no laboratory like the National Physical Laboratory, nor a Building Research Station, nor a Road Research Station, as they have in Great Britain. But the results of researches carried out in foreign countries are available to us and we are in the fortunate position to profit by them, to test them, and where necessary, to modify them, in their application to the special conditions of this country. Building and road materials can, to a certain extent, be tested in the Government Test House at Alipur but it does not cover the whole field of research. For instance, the compressive strength of a stone can be tested at Alipur but it is not the sole test of its suitability for building purposes. Investigations into the weathering of stone have opened a new method of judging whether it is suitable for building purposes or not. Researches on shrinkage and creep of concrete disclose important factors to be considered in the design of reinforced concrete structures. It is because of these researches that the modular ratio for design purposes is taken higher than the true or instantaneous value. The tensile strength of cement mortar has long been known as a useful means of ensuring a satisfactory cement for general purposes but recent research has shown that it does not provide a measure of the value of cement in making concrete. New conceptions of concrete-making have been derived from Abram's investigations on the water cement ratio.

5. Researches at the Dehra Dim Forest Institute on the preservation and seasoning of wood are likely to lead to the more extended use of Indian timbers. As a result of the introduction of proper methods of air and kiln seasoning, cheaper woods have now displaced more than half of the more expensive teakwood used 12 years ago in the construction and repairs of railway carriages. A new discovery is the wood preservative ASCU which, it is claimed, is superior to other known antiseptics, particularly for the preservation of perishable wood. This discovery has made it possible for indigenous timbers to compete with steel, iron and concrete for structural purposes.

6. Research into the acoustics of buildings and the sound absorbing properties of materials have resulted in, a more satisfactory design of auditoriums and in improving the faculty acoustics of existing buildings. As a result of experimental research, earthquake resisting structures are now possible.

7. Coming to the subject of "Roads" I should say at nee that the road engineering in its present

stage is more an art than a science. The object of research work connected with the roads aims at the formulation of a science of road engineering so that materials can be used in the most efficient and economic manner. In the past, the foundation of a toad did not receive the attention it deserved. It is only during the last few years, that foundation studies and soil research have been undertaken. The subject of soil physics is still in its infancy and the properties of soil which are dependent on loading and change of moisture are under investigation. Tests on the shearing strength of soils (friction and cohesion) indicate that it should be possible to design earthwork which will lead to the most economic height and shape of cutting an embankment. Speaking broadly, no important advance has so far been made but these tests are yielding accumulated knowledge which may afford a reliable basis for estimating the important foundation characteristic of a given soil.

8. Since the advent of motor cars and mechanical means of transportation, the surface treatment of roads has been receiving increasing attention. New methods of construction and new combination of materials are being tried to meet the needs of modern heavy traffic. Apart from researches on the properties of materials, the methods adopted are still empirical. The iron tyred bullock cart is a serious factor to be reckoned with in the design of road pavements in some parts of this country, and the problem of constructing a road suitable and yet economical both for pneumatic tyred and iron tyred traffic is a most difficult one. In a number of foreign countries the construction of roads intended solely for motor traffic has been undertaken. From the point of view of facilitating fast motor traffic into two or more lines and the avoidance of accidents, there is no doubt, they afford a definite advantage but few countries and specially a poor country like India can afford such a luxury on a large scale. They cannot possibly be justified from the economic point of view nor by the volume of traffic on our roads.

9. So long as traffic conditions in this country remain what they are, we have to make the roads to suit the traffic. To solve this problem a great deal of research work has been done by commercial firms interested in the manufacture of tar and bitumen. But people not connected with these firms or their products find it difficult to compare one product with another without an inside knowledge of the materials used. The only way to compare one material with another is by actual trial on a road but this comparison is also very difficult, as conditions on two different places even on the same road may be different. Efforts have been made to correlate the various mechanical and physical tests of bituminous materials in the laboratory with their behaviour on the road but so far no practical results have been achieved, and it seems, no useful results, adaptable by practical engineers are likely to be achieved for many years. The attempt to test under various permutations and combinations of temperature, light, rain, volume of traffic, unit pressure, speed of vehicles etc. with the actual but different conditions of roads is too difficult an undertaking to be completed for many generations. This consideration has led to the development of machines, in which short length of roads can be tested under actual traffic conditions but in much shorter time. Unfortunately the shortening of the time lactor is likely to vitiate the result but it is believed that the use of machines, if confined to extreme conditions, will give safe results.

10. It may be said that while it is impossible to subject flexible roads of tar and bitumen to the usual method of stress calculations, it should be possible to analyse the stresses due to loads on a rigid road of concrete. Now mathematical analysis is a rigid machine which works with absolute accuracy upon the data supplied to it. If the accuracy of the data is doubtful, the result is doubtful. This is so in the case of roadway slabs. It is not possible to decide definitely in what way the slab is supported, as this depends not only upon the soil but upon movements which occur in the concrete itself owing to moisture and temperature. Again there is the complexity caused by the 'curling action' owing to variations of moisture and temperature. These difficulties have not been overcome and so far no rational analytical method for the design of roadway concrete slabs has been devised. But sufficient experience has been gained to accept cement concrete as a

suitable material for roads under heavy traffic. The trend of design in foreign countries is to make thicker concrete slabs but against this practice, the engineers in the United Provinces have constructed many miles of concrete roads of smaller thickness, which for a period of over ten years has given cornplete satisfaction. Recent experience seems to indicate that even this thickness is in excess of traffic requirements in some places and a length of 25 miles of the Grand Trunk Road has been reconstructed in plain cement concrete with a slab of $3^1/_2$ thickness on existing water-bound surface. This road is probably the longest thinnest concrete road in the world. They are in fact going a little farther and a short length of cement concrete road with a thickness of only 2" reinforced with steel has been laid on the Jhansi Road, Cawnpore. This was 18 months ago and so far the road is in very good condition.

Gentlemen, this Institution is not in any way directly connected with research work and I have taken too much of your time to indicate the lines along which researches are being carried out for buildings and roads but I am sure every engineer in his own line is interested and may also be engaged in research work. This Institution should, I think, be a channel through which the experience gained in one part of this country may be communicated to another. India is a country of vast distances and it seems to me an undeniable fact that engineers in one part do not know what is going on in another part. Advantage should, therefore, be taken by one province of the experience gained in another. How this object is to be achieved is for the consideration of the Institution.

Shri Fakirijee E Bharucha

L.M.E., M.I.Mech.E., M.I.E. (Ind.)

President 1937-38

Presidential Address

About half a century ago it was generally a rule in this country to relegate those young men who were dunces and backward in their scholastic career to receive a training in mechanical engineering, as they were considered unfit for the so-called noble professions of law, medicine and civil engineering. Aristocratic prejudice against manual work was responsible for this sort of looking down upon mechanical engineering, as a profession of dirty hands and clothes in those days, and you now see one of those unfortunate dunces standing before you and occupying the chair of. the President, which was so ably adorned by my many distinguished predecessors. I thank you, gentlemen, for the high honour you have done me by electing me as the President of this great Institution for the year, which I fully appreciate.

As the presidential address is most frequently to be concerned with the branch of engineering; of which the author has made a speciality, I will restrict my address mostly to the branch of engineering profession in which I have spent about half a century.

The mechanical engineers of this country have to perform most important duties, not only in studying and harnessing the forces of nature for the use and comfort of mankind, but also in helping in the resurrection and regeneration of our indigenous industries. Almost all the other branches of engineering are now getting more or less mechanical, but mechanical engineering has its destiny closely linked with power industries and industrial enterprises. It is, therefore, the most important branch of engineering without which no civilized country could thrive and have a place of honour in this world, and no other branches of engineering profession could exist without its help and co-operation.

Steam Engineering— Past and Present.

Some very interesting and instructive facts could be recalled if I were to dig deep into the past half a century when I was an apprentice in a cotton mill in Bombay. Mills in those days were driven by huge slow speed steam-engines supplied with steam from low pressure boilers. Progress in steam generation was very slow in those days, and even in the early years of this century, the boiler pressure was not more than 180 lbs. in Bombay mills.

In or about 1905 the gas engine came into the field, and one enterprising cotton mill in Bombay ordered it out for its drive. It gave a lot of trouble and failed as the gas engineering was not much understood by engineers in those days. Then came the Diesel into this country, but as the science of internal combustion engine was still in its infancy, the Diesel did not make much headway then in this country. In those days the steam turbine of the bleeding type (giving power and heat combined) was not known for mill driving, and the engineers did not know that it could work on the same heat consumption as the gas or Diesel engine, as it does now.

The modern steam-electric power plant can now consume about 10,000 British Thermal Units of heat per kilowatt per hour. This is a remarkable progress achieved specially owing to the intensive research work and advancement in combustion engineering. The modern water tube boilers are equipped with improved furnaces surrounded with water walls, and generate highly superheated steam with the help of pulverized coal firing and air preheating.

The technique and the special feature of a modern large steam power plant lie in the automatic combustion control made available with the help of electrically worked devices. With the help of ingenious instruments the efficiency of the steam boiler has been increased from a maximum of about 70 per cent obtained in or about 1900 to about 90 per cent now. The science of combustion engineering is now better known and understood than what was about 30 years ago.

By automatic combustion control is meant the prevention of smoke, maintenance of load against demand, carrying out routine adjustments, group control of boilers, increase and maintenance of boiler house efficiency, provision of interlocking safeguards against accidents by protective cut-outs and devices, etc., all of them automatically controlled.

During the past thirty years the working steam pressure has increased from 180 lbs. to 1,800 lbs., and the size and output of a boiler from 10,000 lbs. per hour to 500,000 lbs. per hour.

The greater part of the power now produced in the world is by means of steam, and the proportion of steam power is constantly on an increase. The formidable rivalry set up by the increased thermal efficiency obtained in Diesel engines made the steam plant builders sit up and think seriously over the question of increasing the efficiency of a steam plant. They knew they could not do much improvements in prime movers (engines and turbines), but they found out that much heat was wasted in boilers, which could be prevented by increasing the combustion efficiency; and with the help of scientists and mechanical engineers much research work was done in this direction, and the water tube boilers were much improved in their design and construction.

The latest addition in the improvement of a steam power plant is a new type of a steam boiler aptly called "Steam Generator." It is entirely different in design to the conventional type, occupies about one quarter of the space, and does not require brick Rues or chimney. It is a vertical steam generator, entirely automatic in its working and shows an efficiency of about 93 per cent besides making a great saving in the cost of maintenance. It could be erected by the side of the steam turbine in the same room and is automatically fired with fuel-oil on the principle of combustion under pressure, the product of combustion escaping through an exhaust pipe just like the exhaust of a Diesel engine and not through a tall chimney. It can generate steam pressure of from 300 to 1,000 lbs. or even more according to the design. The steam pressure and the water level are always kept constant automatically, and when the water supply fails the fuel supply is also cut off automatically. This is all due to the combined and unremitting efforts of mechanical engineers and scientists. Many engineers think that for the large requirements of power and heat for industrial processes combined, a modern steam power plant cannot be beaten by any other power system. Science of power house engineering and combustion engineering have made great strides during the past decade. Consequently the steam plant is still holding its own specially for large power houses against the competition of internal combustion engines.

The aim of the steam engineer is to get the highest possible thermal overall efficiency by supplying cheap power for factories and cheap heat for process work such as required for boiling, dyeing, sizing, bleaching, drying, etc. The utilization of exhaust steam for heating is a sound economical problem and though the actual thermal efficiency of steam power prime mover has not been more than 25 per cent in the most modern one, it is possible to get an overall efficiency of more than 50 per cent if the exhaust steam is utilized for heating, after it has generated power instead of sending it to a condenser.

Internal Combustion Engineering.

The internal combustion engines, however, specially of the Diesel type, have been making steady progress for small industries in which the old single cylinder non-condensing steam engines of the steam-eater type are being fast replaced by Diesel engines in this country. The thermal efficiency and fuel comsumption in small and large steam plant are not so constant as they are in an internal combustion engine. In fact the steam plant has almost been driven out from small industrial factories by the oil engines, as shown by the figures of import into India of both these power plants given below :-

	1935-36	1936-37
Oil Engines and parts	Rs. 68,86,000	Rs. 81,31,000
Steam Engines and parts	" 9,87,000	" 13,28,000

The Diesel engine is however considered by some as the future power plant and it is now used on road, rails, sea and air transport, besides in industrial factories.

Diesel fuel oil is not so inflammable as petrol, and though the Diesel engine is still heavier than the petrol engine used in the air-craft, attempts are now in progress to reduce its weight to about 2·5 lbs. per horse power, which is almost equal to the weight of petrol driven engines now employed in the air-craft.

Looking to the large trade and demand in oil engines as disclosed by the figures given above there is no reason why it could not be manufactured in this country out of indigenous raw materials and with the help of cheap labour and also with a vast market for the finished product at our door. Some attempts were made in this direction in this country, but they all failed owing to several reasons. One very successful and praiseworthy venture has, however, been made by the Hindoostan Engineering and Implement Co. Ltd., of Satara, started by Sir Dhanjishah Cooper, lately the Prime Minister to Government of Bombay. I have personally inspected and tested one of these engines on several occasions and found it satisfactory in every way. The engine is perfect in design, workmanship and finish, and leaves nothing to be desired. I hope such *swadeshi* enterprise will be hailed and welcomed by all engineers who feel interested in the uplift and industrial advancement of this country.

Some years ago the gas engine working on suction gas plant was used for small industries. Those working on combustible waste product of a factory are still in some demand, if the waste product cannot be sold or utilized in any other way. But the Diesel engine has practically driven it out from the market, because the gas plant is very cumbersome, specially with tar producing fuels.

Power Alcohol.

In view of the policy of prohibition that the Congress Ministry has adopted, much attention has now been diverted to producing power alcohol instead of the potable spirit in our distilleries, and utilize the vast resources of our country available for this industry at our door, such as mowrah flowers, molasses and other inexhaustible waste products of our forests and farms.

The remarkable progress made by our sugar industry in the past few years has made available a very large quantity of molasses as a by-product which could be utilized for distilling alcohol. There has been some difficulty due to restrictions placed by Government in the production of alcohol, but the insistent demand to make use of the waste products of our sugar mills in order to reduce the cost of manufacturing sugar, will help to remove them. Alcohol, benzol and lighter petrol are said to be miscible, and a cheap mixture requires to be produced which can be used in place of petrol in internal combustion engines. The manufacture of absolute alcohol by dehydration process has resulted in producing 99.5 per cent pure alcohol. With prohibition coming into force the country liquor could, therefore, be easily converted into power alcohol by this process, and all the distilleries of our country could be utilized for this purpose, thereby maintaining the excise revenue of our country to some extent, by creating and establishing a new industry.

Some experiments are now being carried out in Mysore State where alcohol is distilled from forest waste, and a mixture of alcohol and petrol is reported to have been evolved which could be used in motor car engines. Unfortunately the calorific value of alcohol is a little more than half that of petrol. But the thermal efficiency of alcohol is higher than petrol, because the temperature of ignition of alcohol is lower and it can stand somewhat higher compression. In spite of these advantages, however, unless the price of power alcohol is about 15 per cent less than that of petrol the former cannot stand in competition with the latter. The process of dehydration has been much improved lately and it may be possible to produce and sell power alcohol cheaper than petrol. All the efforts, therefore, should now be concentrated towards producing power spirit at the cheapest possible rate, so as to obtain a cheap national fuel for power from the otherwise useless waste products found abundantly in our country. This would also stimulate the manufacture of alcohol engines for our motor cars and for other purposes.

I quote below the opinion of the Indian Industrial Commission on this subject, (para 96 of their Report) :-

"On several occasions our attention was drawn to the possibility of making industrial alcohol from hitherto neglected vegetable materials, some of which appear to be sufficiently promising to justify investigation and experiment. We recommend that a more liberal policy should be followed by the excise authorities in respect of the class of denaturant prescribed and more regard might be paid to the likelihood rather than to the mere possibility of frauds upon the revenue, when the requirements of commercial users conflict with excise regulations.

Our Cement Industry.

Our cement industry is a very important one from engineering point of view and we must look to its remarkable progress and marvellous success with pardonable pride. By 1914 there were three cement manufacturing factories in India. During the Great War their output was kept under control of Government. After the war the number of cement factories increased to nine, and in 1924 their output and sale increased to about 263,000 tons per year, while cement imported in India was about 88,000 tons only in the same year. The cement manufactured in our factories was and has been of the highest quality, if not superior to the imported cement in some cases, and owing to unceasing and intensive efforts of the Concrete Association of India and Cement Marketing Company of India, the manufacture and sale of cement produced in our eleven factories have now reached to about 1200,000 tons per year.

In spite of the progress of our nine cement factories that were working in 1924, the following entirely wrong and misleading statement appeared in the ninth edition of "Building Materials," Roorkee Treatise on Civil Engineering, published in 1924 by the Thomason College, Roorkee :-

"Portland Cement :— This is imported in large quantities for use in India .... Limestone and clay suitable for manufacture of cement are very rare in India and this material has therefore not been manufactured locally to any great extent. Kanker yields very good mortar for ordinary hydraulic works, and for special jobs English Portland Cement is commonly used. Madras and Calcutta cements have lately come into the market: but so far there has been no great demand for them in Upper India as far as the author is aware."

I happened to read this in 1928 when the production and sale of Indian cement had increased to about 550,000 tons per year. I wrote a letter to the Times of India drawing attention of the authorities concerned to this most objectionable paragraph in a Government publication; and the Concrete Association of India wrote to me saying that they had taken up the matter with the Principal of the College.

It is a great pity and seems impossible to believe that the authorities of the Thomason Engineering College in Roorkee as well as the Public Works Department of the United Provinces were not aware of the progress of the cement industry in our country in 1924, and allowed this monstrous statement to appear for years in a book meant for training our young civil engineers in one of the important engineering colleges of this country. It was a case of amazing ignorance.

The Manufacture of Machinery.

Besides the manufacture of Diesel engines and assembling of motor cars, etc., manufacture of various kinds of machinery also has been undertaken by several engineering works. This is a healthy sign of our industrial revival and advancement. Hydraulic and power presses for various purposes, machine tools, flour mills, rice and dal mills, sugar-cane crushers, oil mills, groundnut shellers, cotton openers, saw benches, ploughs, cotton gins, power looms, mill gearing, biscuit making machines, pumps of all kinds, grinders and polishers for flooring tiles, printing machines, soap making machines, electric fans, pulleys, etc., etc. are now successfully manufactured in this country for which there is very good market.

In hardware lines door and window fastenings and fittings, steel safes, buckets, cooking utensils, agricultural implements, fire-proof doors for mills, steel furniture, valves and cocks, steel ornamental railings, pans and pickaxes, etc. of excellent quality are now made in this country.

All these come within the province of mechanical engineering, and the young mechanical engineers should therefore devote their time and energy in these directions, and keep themselves abreast of the times. It is a fallacy to suppose that mechanical engineers are required to know only the upkeep of prime movers of factories or management of mechanic shops. Times are changing fast and there is good demand for scientifically trained engineers who could not only take charge of and maintain power plants in order, but also look after the industrial machinery and plant inside a mill or factory, and work it with high efficiency and economy. They should try to design and manufacture hardware and machinery in this country out of indigenous iron and steel now available.

Mechanical Engineering Welded to Industries.

India is going to stand before the world in near future as one of the most modern industrial countries. We have coal, petroleum, cotton, jute, sugar, cement, gold, iron, oil seeds, etc., besides many minerals and forest produce in this country. Since past quarter of a century we have made great and remarkable strides in our indigenous industries and the late war accelerated the movement. Owing to the tariff protection given to several of our industries, such as textiles; iron and steel, cement, sugar, matches, etc., a demand has sprung up for technically and scientifically trained young men. A large number of young Indians are being sent every year to Europe and.

America to receive higher training in technology and engineering.

More and more unexplored and undeveloped regions are now coming in contact with the modern civilization owing to the ever increasing facilities in transport and travel by road, rail, sea, and air routes. In this way Afghanistan, Iran, Iraq, Arabia, Asiatic Turkistan, Tibet, etc., have been brought nearer and nearer to this country. Government of India have appointed Indian Trade Commissioners in adjoining foreign countries for the purpose of helping and developing our export trade. Our industrialists so far did not care to find out fresh fields for the products of their manufacture.

I am tempted here to quote a very relevant para from the latest report of our Ceylon Trade Commissioner to prove that a very great field still exists within an easy reach of India for its textile trade which has been so unfortunately neglected and overlooked during the past, owing to the morbid lethargy of our mill-owners. He says, "The population of Ceylon to-day is 5,678,000. Applying the criterion of Manchester Chamber of Commerce, namely that in India the consumption of cloth can be reckoned at about 13 yards per person per annum, Ceylon with her single spinning and weaving mill and with a domestic production of less than nine millions of yards, must continue to consume annually more than sixty million yards, of which India, in spite of her proximity hardly supplies one third. The Indian producers have either not studied the Ceylon market properly or have not the necessary machinery to produce the type of cloth consumed in Ceylon.

Our export of Indian mill made cloth to foreign countries before the Great War was not much, and the mill-owners had not done much to find out new avenues for our textile trade outside India. During the war our export rose to about 150 millions of yards of cloth, which had come down to about 60 million yards during the past two or three years. It has risen to about 80 million yards again during last year. We have been now exporting our textile goods even to Australia, Iran, Egypt, Siam, Malay and African ports, etc. It is now up to the Mill Owners' Associations to send their permanent representatives to these and other foreign countries to further develop and maintain this newly created export trade.

Similarly we have succeeded in increasing the production of our many other large industries. The outturn of iron and steel, sugar, cement, matches has increased enormously during the past decade and we are now in a position to export large quantities of these indigenous products of our manufacture to foreign countries, after meeting with our domestic requirements.

Our Industrialists.

As I have mentioned before the mechanical engineering is closely welded to industries and I cannot therefore do justice to the profession unless I deal with industries at the same time. There are reasons why our industries do not thrive and expand rapidly as they should. Our industries are mostly financed and controlled by men of means most of whom have had practically no training in science, engineering or technology. They do not care to take up technological experts as partners or directors in their managing agencies, and select such men as officers who are willing to serve on the lowest wages. In some instances that came under my observations I found that the managing agents or directors of large mills or other industrial concerns did not even know how to select the right man from amongst a heap of applications received for a vacant post of an officer, and often relegated such work to their equally ignorant head clerks. It would be very interesting to find out and know the number of directors of large industrial concerns working on joint stock basis who have received adequate scientific training in technology or engineering pertaining to their own works. In other civilized and well advanced countries the expert works manager is often a director or managing director in the concern. In India; on the other hand, the vocational or technical education is considered inferior to literary education and I know of instances in which even graduates in arts have been asked to prepare schemes for technical and vocational schools. The unemployment amongst the masters of arts is increasing in this country; but there is a dearth of mistrees of art. It is very difficult to develop our industries and engineering trades without the help of skilled and educated officers and artisans.

Technical Education.

Besides a few engineering colleges there are some technical institutes in this country giving instructions and diplomas in civil, chemical, mechanical and electrical engineering, and some small vocational and industrial schools teaching hand weaving, soap making, leather manufacture, cloth dyeing; and printing, carpentry; and iron work, etc., etc. But there is not a single technical high school or a polytechnic institute worth the name for giving scientific and practical instructions in the technology of various industries of everyday requirements in this vast country of 350 million souls.

The foundation for industrial and vocational education requires to be laid early in a boy's life. Our matriculates are rather precocious boys. We stuff too much in their brains during their premature life and do not have them do anything with their hands, in which they could excel and take a just pride. The technical high school, which I suggest, need not be a trades school, and should not aim at giving training in any particular vocations. Its aims and functions should be strictly to give sound training in English, mathematics, science, engineering drawing and use of tools (both hand and machine), and prepare the boys for further practical and scientific training in any vocation that they may choose to follow subsequently in other higher technical institutes, industrial mills or factories, power houses, engineering works, or in a polytechnic institute.

There is still a vast undeveloped field in technological and engineering training in this country. Electrical installations in small towns are rapidly increasing, which will give a great deal of stimulus to small and large new industries. A very large number of cottage hand-looms have now been converted into power-looms in Surat and other industrial towns.

A bias or liking for hand work and technical vocations requires to be inculcated in the boys from an early age; through well-graded courses in schools, on Kindergarten and Sloyed systems. The educational hand work should be taught as one of the subjects of the daily curriculum by a specially trained teacher and not by an illiterate bazar artisan.

No educational system is complete and perfect which is not based on the principles of physiology of the brains and voluntary muscles, and which does not include the training of, the brain, eyes and hands simultaneously with the help of educational hand work in carpentry. It has now been recognised by the eminent educationalists of the West that no amount of lessons in prose or poetry learnt by heart from textbooks can cultivate character or intelligence or love for truthfulness, as much as can be done by well-organised courses in educational hand work or manual training in the schools. In the absence of such a training, thousands of young lives have been wrecked physically and mentally as regards success in life. Do we not know from our everyday experience that many of those who have been failures in the schools have actually risen to positions of distinction in their after life without the aid of college education?

Having served as a teacher in an Engineering College and also as an inspector of technical schools oi Bombay Presidency for several years, I say from my personal experience that many boys seek admission to engineering or technical colleges without having any idea of what engineering or technology really is. I know of some instances in which students applied for admission in arts, law and engineering colleges simultaneously, in the absence of adequate vocational guidance. In the rules of some of the engineering colleges it has been wisely laid down that if a student fails twice successively in the first year examination, he is asked to leave the college, because it proves that he has no natural liking in engineering and is quite unfit to assimilate the training. But this sort of weeding out of misfits during the first two years means waste of time and money.

Mere technical training without the opportunities and means of employment in industrial factories will be of no avail. The question is — should the technical training precede the industrial undertakings or vice versa? Examples of various European, American and Japanese countries are often cited in which there are large and numerous technical and polytechnic institutions as compared with very few ones, (some of lower grade) in this country. But it is a fact well known that industrial organisations always preceded the establishment of such technological institutions in those countries. We established our textile, iron and steel, cement and sugar industries in this country, before putting up our technical colleges and schools for giving training in these industries. Of course we had to import technical experts for our new industries from foreign countries in the beginning. The same wise course was followed by Japan, and within forty or fifty years it has come out as one of the most civilized and advanced industrial countries in the world.

Industrialisation of India.

There are some people interested in exporting our raw materials to foreign countries and importing finished goods into this country, who continue to say at the top of their voice that this being necessarily an agricultural country we must concentrate all our efforts and energy to producing better agricultural products only. This may be right as far as it relates to the improvements and new methods to be introduced, and the efficiency to be increased in our agricultural activities; but there is no sense in sending our raw materials to be manufactured into finished articles for us in foreign lands, when we could do it ourselves. Only a few months ago Sir Vishweshwaraya the well-known industrialist, and formerly chief engineer and Prime Minister of Mysore, stated in a public speech delivered at Poona :-

"The entire per capita income can be doubled if the industrial and economic drive is taken in hand as in Russia. All the man-power must be mobilised and the agriculturist population must be slowly converted to help industrialisation."

India being mostly an agricultural country she has practically no control over her economic development. India still exports a large quantity of raw materials, and a depression in trade in foreign countries means lower prices realized by India for her agricultural products. This in turn affects the purchasing power of the people. There are about 250 million agriculturists and their dependents in our total population of about 350 millions. If we could make these 250 million agriculturists earn only Rupees ten per annum more per head, it would bring about Rs. 2,500 millions (250 crores) more into this country than usual, thereby increasing the purchasing power of our people, and at the same time creating a large demand for our manufactured goods out of our indegenous products. This in turn would immensely help our engineering trade closely connected with industries,

Conclusion

In conclusion, gentlemen, I am afraid I have bothered you much by touching at length our industrial and economic problems, instead of giving you a discourse, on mere mechanical engineering; but as I have told you before, I could not sever one from the other. In connection with this the late and much lamented Sir Rajendra Nath Mookerjee, President of this Institution (1921); in his inaugural address; very wisely said :- "Though the Institution is a non-political body, it must largely interest itself in administrative and economic questions .... It is desirable that engineers should exercise a more effective voice in the administration of the country than has hitherto been the case."

India is a country of vast resources, but it has passed through great vicissitudes; and if I have succeeded in setting industrial engineers thinking on various economic problems I shall have the satisfaction to know that I have done my duty towards this great Institution, in the foundation of which I had my humble hand along with others.

Shri Fakirijee E Bharucha—a Brief Profile

With the passing away of Sri Fakirjee E. Bharucha (b 10th April, 1871), LM.E., M.I.E., M.I.Mech.E. (London), on 31st August, 1950, at the ripe old age of 80, the engineering profession of India has lost one of its most active and distinguished members. After his early education in the Elphinstone High School, Bombay, the late Sri Bharucha joined the Victoria Technical Institute, Bombay, in 1888, for his studies in mechanical engineering. He was one of the first batch of students at 'the Institute and passed with first class honours in 1891. He repeated this success with a first class in the Government examination for mechanical engineering in 1895. In the years following, he gained practical experience as engineer and manager of a number of textile mills and industrial concerns at various centres such as Nagpur, Wardha, Ahmedabad, Amritsar, Lahore, etc.

Sri Bharucha's wide practical experience and literary attainments in mechanical engineering and technology earned for him the post of Assistant Professor of Mechanical Engineering at the College of Engineering, Poona, in 1908. Here he designed the new Engineering laboratory and supervised its construction. After nine years of service as Assistant Professor, Sri Bharucha was made a senior professor of Mechanical Engineering.

Sri Bharucha's valuable services to the engineering profession were soon recognised and he was transferred to the Public Works Department as Executive Engineer in charge of Central Stores and Workshops at Dapuri near Poona, and then to the Department of Industries as Assistant Director in 1919.

Sri Bharucha actively associated himself with technical and engineering education in the State of Bombay. Even while he was on the staff of the College of Engineering, Poona, he served during the five summer vacations as Inspector of technical and industrial schools in the State. He was also invited by the University of Bombay to examine the University alumni in mechanical engineering. Sri Bharucha also served as a member of Board of Examiners for mechanical engineering under the Indian Boilers Act. With the reorganisation of the Department of Industries in 1925, Sri Bharucha was appointed its first Director. As Director of the Department of Industries he was interested not only in the development or large scale industries but was actively concerned with the progress of small scale and cottage industries such as hand weaving, dyeing, pattern-printing on cloth, etc., and was naturally impatient when the Government did not take up his proposals.

Sri Bharucha was a prolific writer and a capable organiser. He took an active part in starting the Bombay Engineering Congress (1915) and the Institution of Engineers (India) (1920). He read several papers before these learned societies and the Bombay Textile and Engineering Association, of which he was the President since 1930. He was the Editor of "The Engineer" during 1933-50 and has a number of publications and pamphlets on engineering and general topics to his credit. He was a well-known authority on boilers and textile machinery and gave expert advice to many mill-owners all over India. The Government showed its appreciation of Sri Bharucha's service by extending the term of his appointment by one year and adding six years to his actual pensionable service.

In spite of the numerous duties of his profession and responsible post, Sri Bharucha was keenly interested in the welfare of his community. He was instrumental in founding the Parsi Hunnar Shala, Bombay, a technical institution for training boys in useful occupations such as carpentry, joinery, smithy, etc. But the institution with which he was closely associated and which he helped to organise was the Parakh Parsi Polytechnic at Surat where the youth of his community receive training in automobile, electric and internal combustion engineering.

Sri Bharucha's social activities were many and varied. He was on the committees of a number of social, economic and scientific institutions. These and other institutions with which he was closely connected and which he helped to build up, and the engineering profession are now deprived of the wise counsel and guidance of Sri Bharucha, who has left his mark as an engineer, an orgaruser, an educator, a writer and a man. Sri Bharucha was the President of the Institution for the year 1937-38.

Mr E J B Greenwood

M.Sc., M.I.E.E., M.I.E. (IND.)

President 1938-39

Presidential Address

Gentlemen,

The Council of the Institution, as your representatives, have elected me to be your President for the ensuing year and I should like first to express my thanks for the honour conferred on me. The honour carries with it a 'substantial' measure of responsibility and my distinguished predecessors have created a standard of industry and wisdom which I can but strive to emulate. It is particularly gratifying to my sense of pride, and I trust excusably so, to have my name coupled with that of the distinguished engineers who in the history of the Institution have occupied the responsible and onerous position of President. Fortunately the tasks involved do not fall on the President alone. He is helped and advised by a Council and its various Committees of men long experienced and skilled in the engineering arts, and by a secretariat whose efficiency has stood the test of many years of service. I can only say I shall do my utmost to uphold the high traditions of the office and to endeavour to push forward the interests and activities of the Institution and its members. As must have been the case with previous Presidents, I find time the most valuable matter in existence; as one grows older there is more and more to do and inevitably never sufficient time to do it.

The Institution born in January 1919 was formally inaugurated in February 1921 and I may add I was fortunate enough, as a representative of Madras, to be a member of the original Organizing Committee and later to attend in Calcutta that inaugural ceremony presided over by Lord Chelmsford, Viceroy and Governor-General of India. In subsequent years I have been fortunate enough to attend the various annual meetings of the Institution until the last few years when pressure of official work has prevented my taking the long journeys inseparable from an institution which holds its annual general meetings at different places throughout a country which in itself is an empire.

The membership now is 1,472 after nearly 18 years of steady work. I am not going to say it is inadequate but I do affirm that we represent the main body of engineers in India. The Institution is securely founded and the grant of a Royal Charter in 1935 by His Majesty the King-Emperor has definitely given us a recognized place in the engineering world. I would do nothing to accelerate the membership of the Institution. I would eschew all schemes which have the sole object of increasing our membership to the detriment of the standard laid down in our charter. Membership of the Institution is the hall-mark of a qualified engineer; it is an honour not lightly bestowed; the standard is set by our charter and — unless we are false to the trust so placed in us — that standard cannot be reduced. I fully admit that in the changing conditions of our engineering development in India some changes in our charter will inevitably and gradually become necessary and I see no reason why we should not from time to time petition His Majesty The King-Emperor through the concerned Committee of his Privy Council to that effect; our charter is recent, 1935 and so it is unlikely. that the changing conditions warrant any worthwhile petition for many years yet. I am glad to note a growing number of members anxious to effect improvement in the activities of our Institution and, subject to our Bye-Laws read together with clause 20 of out charter, there can be no possible objection to improvement : I would beg those keen members to pursue their aim in all friendliness and patience. The Institution has for many years been the Indian Committee of the British Standards Institution and of the International Electro-Technical Commission.

I view with mixed feelings the attempted growth in ·India in recent years of kindred institutions of an engineering nature; the fold of our own Institution is wide and our-membership includes distinguished representatives of all branches of engineering and its allied sciences. It is conceivable and will inevitably occur that our Institution will form special sections to deal with subjects such as railways, irrigation, water supply, electricity, reinforced concrete, where concentrated discussion on those subjects can take place. All such sections however, will remain integral parts of the Institution and we may visualize a state in the future when our Institution consists entirely of such sections controlled by, I trust, an unenlarged but truly representative Council.

The coming year may see some progress in the setting up of a standardising institution and possibly some move forward in the matter of an Engineers' Guild or Register. I am uncertain that our interests will be improved by an Engineers' Guild or Register. It seems, inevitable that the economic status of our profession will, by the application of a reasonable degree of commonsense and initiative, take care of itself. It cannot be denied that the profession as a whole has done reasonably well as compared with the other recognized professional callings. The formation of a register if carried out on broad lines may prove of benefit to the public at large as at present many public bodies have inadequate understanding of the canons of tendering, the niceties of technique and the execution of competently engineered works. I feel strongly that legislation is the last thing we desire or require to uphold our profession. As voiced by our N. W. of I. centre, members can do much more for themselves and for the profession in general -by being more particular in their selection of staff, contractors and patronage.

The preparation and presentation of papers to technical institution is of great importance to the profession but we can and should do more than that. I think engineers should be more publicly assertive and by articles and letters in the Press lose no opportunity to educate the public in the economic value of sound engineering. Erroneous statements concerning engineers and their works should be challenged and the omission of suitable mention of engineers when important works are being opened or described should be protested against. Retired engineers and those who can afford the time should participate in local affairs by becoming councillors or members of local boards. At present local administration is mostly in the hands of lawyers, schoolmasters, doctors and other public spirited persons; engineers might well follow in their footsteps. The status of the engineer would be so much improved by some check on the inadequate salaries now offered and perforce accepted; such pittances recoil disastrously on the standard of the profession.

In the present stage of this country in so far as its material progress is concerned we as engineers should, I consider, strive for its industrialization. I am not unmindful of civil engineering progress in the fields of railways, harbours, irrigation and water supply or of electrical engineering progress in its hydro-electric and thermo-electric power stations and vast distribution systems, but such works are only a means to an end and, that end in the eyes of the world is manufacture and the international trade arising therefrom. We cannot rest content admirable though the design and execution of the works and their benefits may be-with the construction and operation of irrigation and water supply systems and the improvement in the lot of our vast agricultural population: we must press for more industrialization, for in industrialization alone lies the key to the problem of raising the standard of living of the peoples of this country. In my opinion no nation can develop its vitality and well-being by an existence entirely within its borders: it must by exports and imports range itself in competition with the other nations of the world and so establish its place and pride of existence.

There can be no gainsaying the relative importance of the engineer in the universe as an ordered whole. In India much emphasis and attention is paid to the lot of the agriculturist; and about him I would like to digress for a moment. The plough of the agriculturist is rapidly becoming steel shod: what a wealth of industry and engineering ability that ploughshare with its fixing screws or nails envisages! Mining, winding engines, steel works, railways, machinery and so on. Even the agriculturist's loin cloth has practically no being except through machinery; I understand the great majority of Khaddar is made in modern power mills. For its food, clothing, furniture and every single need the world is entirely dependent on machinery and the engineering profession. We need not and do not lose our sense of proportion however: every walk of life, whether labourer, administrator, doctor, physicist or soldier has his place and pride of place.

India has been slowly but surely advancing in the realm of manufacture: apart from agricultural materials such as cotton, jute, sugar, tea, wool, leather, we have a number of important works for the manufacture of iron and steel, paper, chemicals and in more recent years for the manufacture of machinery, bridges and the like. In fact the last few years have witnessed a considerable advance in the industrial progress of the country. Since the stimulus given to industries by the labours of the Industrial Commission there have been in the last 20 years a considerable change in the relative importance of the different classes of industries in India. As viewed from the number of persons employed cotton and jute still remain our major manufactures, although jute has practically stood still, but recent years have seen the enormous growth of the sugar, tea, cement and match industries, while the expansion of engineering 'works including railway workshops has been most marked. Most welcome is the attention and study now being given to the intensive utilization of our hydro-electric and mineral resources as distinct from the agricultural. Excluding coal and petroleum, I am afraid economic considerations will mitigate much utilization of our mineral resources unless heavily supported by import tariffs or until large blocks of very cheap hydro-electricity become available; the commercial manufacture of basic chemicals and the smelting of our metallic ores cannot be undertaken in small factories. Too often in the selection of sites for factories is the importance of the water supply overlooked; considerations of the distance from the factory of one or more of the principal raw materials including the fuel or the power and the distance to the market or to the port for the finished product are rendered void if the water supply is inadequate in both quality and quantity not only for the process of manufacture but also for the labour force attracted to the locality; in some cases the effluent from the factory is also a matter of most serious consideration.

Manufacturing progress has been slow but very sure. Every factory has its own methods and details of manufacture, and some are rightly secret. There is however, a great necessity for the writing of papers on industrial subjects and for recording the various methods and details so that industry may advance by knowledge of the past and of its avoidable mistakes. I would like to see the papers presented to the Institution deal more with the industrial application of engineering than with engineering science itself. Every manufacturing works contains some nucleus of research not necessarily in apparatus of a testing nature, but in experimental processes. While the majority of firms cannot emulate the Tata Iron & Steel Works at Jamshedpur, whose large laboratory solely for metallurgical research is a clear indication of the great commercial benefits of research to that industry, a great deal more could be done by the leading firms in the other industries. Our educational institutions in the last ten years have not rested content with importing knowledge, but have set up equipment with facilities and men to carry out research.

In our everyday life there is considerable interdependence between the engineer, physicist, chemist, doctor, biologist and the like. There is no public utility where in the processes or working carry on without the universal spread of specialist knowledge. A water supply works is a good example of the interdependence of the geologist, engineer, chemist, doctor and many others. Our best engineering cannot be done by engineer specialists except as these have a sympathetic and respectful appreciation of the work of other and equally important specialists and will work in co-operation with them. The physicist in particular is becoming increasingly responsible for much research work for the benefit of the engineer: in fact without the physicist there could be little advance in the engineer's design practice. I have in mind the advances in the composition of steel and the ways of adapting it to meet the engineer's needs in utilizing higher steam pressures and temperatures, in dealing with difficult water conditions or in materials subject to rapidly repeated stresses.

I wish to include in this address the subject of the education of the younger members of our profession. It is becoming increasingly recognized that there should be no specialization in the school stage, that what will prove best in after life is a high standard of general education in what I will term the cultural subjects like English, French, and Pure Mathematics together with may be some leaning to the pure sciences .of say Physics and Chemistry; many prominent engineers consider that without good participation in the corporate life of the University an engineering degree is shorn of much of its value as an adequate foundation for an engineering career. In other words the best foundations are primarily the ability to think and to apply principles rather than technical knowledge and secondly the development of personality and ability to mix, handle and control men and not machines. In some quarters already, for example the recruitment to the Civil Service in India and to the P.O. Engineering Department in England, it is realized with practical effect that the examination system is not the only or even the best guide of ability. As it is not possible to make any rapid change in this matter and also I cannot pretend that such universality of opinion has yet been reached I do think we should make some early move to improve the position. I consider that, while there can be no lowering of the standard of intelligence required to obtain a University degree in engineering, there should be a considerable overhaul of all syllabuses to reduce the volume of work so as to be able to emphasize the fundamental principles of engineering science and the proved mental ability to apply those principles. The hallmark of an engineer is not merely theoretical training but sound ability to apply that knowledge to the principles of engineering science out of which only can true knowledge of the subject grow and have its being.

My plea for an overhaul of examination syllabuses does not overlook the fact that every year as a result of research in the properties of materials and in the means of measurement our knowledge of the principles of science is being enlarged. This inevitably means an enlargement of syllabuses dealing with the applications of engineering science. Unfortunately, there can be no enlargement of the already long terms of collegiate study; with the speeding up of commerce by the more rapid means of communication and transport I think that it is unwise to lengthen the period of academic study beyond the present 3 or 4 years. Hence I repeat we must from time to time overhaul every academic syllabus to keep it within the human capabilities of an unlengthened period of study. In this connection, I would remind you that our Institution has been successful in raising the standard of training arid examination of several universities: further, in recognizing the courses of training and examinations of kindred engineering colleges and institutions our Institution has ever kept in mind the standard laid down in our charter: and while accepting some examination tests it has declined to accept many of lower standard.

The education of the younger members of our profession does not rest solely on engineering examinations by educational of even institutional authorities; it is necessary for those of us in a position to arrange matters to provide facilities for practical training in the various branches of each undertaking. Industry in India is carried on in small undertakings; the average daily number of persons employed in our heaviest industry, jute spinning and weaving, is under 4,000 in a single factory. The volume of our large-scale undertakings such as dominate the industries in Europe and more particularly U.S.A. is very small considering the immensity of our population. I presume no one will challenge my stating that we shall make little advance in the industrialization of the country without the setting up of large scale undertakings. I do not decry the field of cottage industries but I maintain that their economic value to the State is comparatively minor. It is impossible to initiate and carry out industries on a large scale unless there is an adequate supply of men specially trained for the direction and management of large industrial concerns. The much desired advance — and there is no denying there is ample scope for the setting up of large scale industries — would be assisted by each industry affording greater facilities to train its own recruits. Many of the larger undertakings already afford facilities for the training of their work people and particularly the younger members but in the broader view the need is for the training of the supervisory grade out of which would rise the directing and managing grade for those men with an adequate background of higher education, general and professional.

I would like with your permission to finish this my address on an individualistic note. emphasizing that engineering in its designs, execution and progress depends entirely and for always on the man. Kipling epitomized the point in the lines:-

"The careful text-books measure
(Let all who build beware)
The load, the shock, the pressure
Material can bear.
So when the faulty girder
Lets down the grinding span,
The blame or loss or murder
Is lain upon the man.
Not on the stuff but upon the man."

Khan Bahadur M Abdul Aziz

C.I.E., .M.I.E. (Ind.)

President 1939-40

Presidential Address

Gentlemen,

I deeply appreciate the honour you have done me by electing me your President for the ensuing year. I wish I had the power to convey to you adequately the feelings of gratitude, pride and humility, with which my heart is full on the occasion. An honour so high, conferred by my associates has given me a sense of elation, hut the realisation of the obligations attached, and the conciousness of my own shortcomings, have made me feel diffident. The confidence of your co-operation, help and advice, however, has encouraged me in accepting the responsibilities you have chosen to place on me. I assure you that I will endeavour to conduct the affairs of the Institution; as best as I can and try to maintain the traditions established by my distinguished predecessors.

2. The object of the Institution as defined in the Royal Charter are "to promote the general advancement of engineering and engineering science and their general application in India." I wish to draw your attention to the fact that these objects are inspired entirely by unselfish motives, and are directed towards the advancement of social order. They recognise that engineering is a profession, and imply the obligation of the professional man, to devote to the good of society, some part of the advantages, which it has enabled him to obtain. This, gentlemen, should be the guiding principle of a professional life.

The primary function, then, of this Institution, so far as its members are concerned, is the maintenance of their high professional standing with social advancement as the chief object in view.

3. It is, however, natural and quite proper for professional men to demand reasonable economic benefits for themselves and their dependants. The Institution may. therefore, rightly interest itself into the economic state of its members, though such interest should be regarded only as its secondary concern. Any action regarding this, taken by the Institution, should be in a spirit of rendering benefit to the society as a whole, and not in the interest of a particular class, or individuals, at the cost of society in general. I stress this point because for some time past there has been a movement among the members to promote legislation for the registration of engineers. A draft of a bill was placed before the general meeting of the Institution last year. The principle of the bill was accepted and a committee was appointed to examine it. I earnestly appeal to you, gentlemen, to reconsider your decision, for, I believe, that registration will not be in the interest of our profession, nor indeed in that of society as a whole. The profession of engineering has not yet sufficiently developed in this country, and facilities for education and practical training are still very limited. Registration necessarily means restriction. and I think. it is not desirable that the number of engineers should in any way be limited. In my opinion restriction by legislation, registration, or in any other form, at this stage of our development will be a shortsighted policy, and will damage our profession in the long run. Further, the proposal savours of the guild or trade union spirit, which is inconsistent with the true ideals of a professional group. So far as the members are concerned it is more important for the Institution. and consistent with it's ideals of public benefit, to set up standards of attainments, and evolve principles of conduct to serve as guides to all engineers, whether in Government service, private practice or industrial organizations. If these standards and codes are accepted by the public, no need for registration win exist. After all, the status of an engineer does not depend on legal devices, but on the respect and confidence he can command from the public he serves.

4. Arising out of the main objects of the Institution, is its most important obligation to ensure that the education and training of students in engineering is on right lines, and is in accordance with the needs of the profession in this country. Last year Mr. Kagal rightly emphasised this point, and proposed the formation of a committee for suggesting alterations in the curricula of technical institutions. Its report will be available in this session. I have no desire to forestall your discussion, but wish to point out that revision of the technical curricula alone will not suffice. The engineer of to-day requires some knowledge of economics also. Not only that. The advent of democracy in this country has made it necessary for him to possess a fair grounding in other social sciences as well, such as Civics and Psychology. Literature on the subject of engineering economics of this country practically does not exist. In my opinion it is time that this Institution encouraged research on this subject, and made its results available to the profession. To illustrate my point I quote an example. The possibilities of new irrigation works, directly remunerative to the state, in this country, are now almost exhausted. By its very nature, however, an irrigation work is never unremunerative to the state because of its indirect benefits, such as larger employment, increased freight for railways, more trade leading to increased income-tax and excise duties, higher land revenue, lower expenditure on famine relief and so on. No attempt has ever been made to correctly assess the monetary values of many of these indirect benefits. Unless these are assessed and credited to their proper sources, further development of irrigation works is likely to suffer.

5. Another question I wish to place before you is the position of the students admitted to the Institution. They come from two classes, (i) students who are still in colleges or have just left them after completing their courses, and are undergoing practical training and (ii) those, who, without joining any recognised educational institution, or having got partial training in them, have secured minor positions in Government service, or industrial concerns, and are ambitious to rise to the full status of engineers. So far as purely technical training is concerned, the former

category is looked after by the Colleges, but the latter also needs some general guidance, and, that, I hold, is the business of this Institution to provide. Our chief object, however, in admitting students to the Institution is to bring them in contact with mature minds in the profession, who are interested in the education of their likely successors. They alone can inculcate the true professional spirit in them, show them the proper function of engineers in society, and their responsibilities to its various sections .

Except providing a few small libraries, and holding examinations to test the technical qualifications of students, we have so far done little to help them. To bring them in contact with professional men by means of meetings and discussions is the function of local centres, but we all know that meetings held by these centres have often been too few in the past, and the papers read and discussions held, have not generally been up to the correct standard. The report of the council for 1939 also shows that, excepting Bengal and Bombay centres, the position in this respect has everywhere been unsatisfactory.

I suggest that we appoint a permanent education committee, whose function should be firstly, to remain in constant touch with technical institutions in this country, and advise them regarding their curricula from time to time, and, secondly, to devise ways and means to advise and supervise the education of the students of this Institution.

6. We owe a debt of gratitude to the founders of this Institution for creating an organization for the engineering profession as a whole. In spite of its various specialized branches, the Engineering profession is one, and the social and economic problems of all its different branches are identical. A central national organization for dealing with such problems was necessary. Nevertheless, for the advancement of technical knowledge, a division of labour within the general body is essential. In my opinion. we have now reached a stage, where the formation of specialized sections is advisable in the interest of technical progress. I am afraid the Institution has not so far been able to do much in this direction. It is true, we have already formed a few technical committees like the one for standardization, but, I think, that similar permanent committees should now be formed for the following specialized branches of engineering: (i) Irrigation, (ii) Railways, (iii) Electrical Engineering, (iv) Mechanical Engineering, (v) Sanitary Engineering, and (vi) Chemical Engineering.

These committees should function either at the headquarters of the Institution, or at other suitable centres. The activities of all these committees should be co-ordinated by the technical Secretary at the headquarters, and published in the monthly technical journal, a proposal for starting which has already been approved. Later on, as need arises, more committees may be formed to deal with other specialized subjects.

7. Our membership has not made much improvement during 1939. It has increased only by 25 members, sixteen of whom are students and companions. The total as it now stands is 1,430. In view of the number of engineers in the country and of its size, I consider, that the profession is not supporting the Institution adequately, and a serious effort by members is needed to increase membership without lowering our standards.

8. During the nineteen years of its existence, the Institution has done much valuable work in overcoming initial difficulties, and consolidating its position. If, in spite of this, I have indulged in mild criticism of its affairs, I assure you, that it is in no carping spirit. I think it is always desirable to make searching sell-examination occasionally, to ensure statisfactory progress.

9. Engineering activity in India has so far been chiefly confined to irrigation and communications. Although our irrigation systems, especially those in the Punjab, are the most extensive and unrivalled in the world, yet 70 per cent of the total cropped area in this country has no facilities whatsoever for irrigation. Most of our resources for providing flow irrigation from rivers have already been or will soon be exhausted. For further extension, we shall have to

rely to a large extent on pumping from underground reservoirs or deep rivers. This needs cheap power.

10. During the past two decades India has made fair progress in industrialisation, but this is still in its infancy, and the rate of progress needs acceleration. The European war, now in progress, has not only demonstrated our present helplessness in maintaining a steady supply of many articles required for use in daily life, but has also afforded a unique opportunity for further advancement in industrialisation. Supply of cheap power is essential for this purpose. Except near the coal-fields of Bihar and Bengal, this is only possible by harnessing water-falls, and the resources of this country in this respect are enormous. A complete and correct estimate of these is not available. Several estimates, varying from 8 to 12 million kilo-watts, have been published, but they are all based on guess work and appear to be rather conservative. Out of such vast resources less than half a million kilo-watts or about 4 per cent only have so far been developed. The three Tata Schemes in Bombay represent half of the total installed water-power in India. The rest of the country has taken advantage of only 2 per cent of nature's generous gift of water-power.

11. Industries like textiles, sugar, cement and steel, which could be developed by thermal power, have made a fair headway, but electro-chemical and electro-thermal processes, which play a large part in the manufacture of products, required in every day life, have not yet been even started. The importance of electro-chemical and electro-thermal processes cannot be over-emphasised. They include such industries, as the manufacture of inorganic fertilisers, chemical nitrogen, potash, caustic soda, chlorine, aluminium, copper, zinc, and certain other metals; melting, refining, alloying and heat treating of iron, steel, brass and ferro-alloys. Without the production of these, scientific agriculture, and manufacture of machinery, armaments and materials for national defence, and other important commodities, is not possible. Most of the articles I have named are not obtainable by any practicable means except cheap electric power.

12. The power requirements of electro-process industries are very large, and the cost of electric power is necessarily a high proportion of the value of finished articles. In most of the other industries, the cost of power in Europe and America is two to three per cent of the selling price of the finished product, but in electro-process industries, the power cost, at very low prices ranging fom 1.5 to 3 pies per unit, amounts from ten to fifteen per cent of the sale value of products. For instance, in the case of aluminium, power at 1.5 pies per unit accounts for 15 per cent of the sale price of the metal. Similarly, for caustic soda, power at 3 pies per unit is 11 per cent of the sale value. On account of the large requirements and cost of power, electro-process industries are bound to be located in areas where power can be purchased cheaply and not merely at places where raw materials are available.

13. The Himalayan valleys and foot hills, where large perennial rivers and their numerous tributaries descend on to the plains, afford great scope for the development of cheap power. Most of these places are situated within easy transmission distances of centres of population in Upper India, which should provide ready markets for electro-process manufactures and electrical energy. An interesting scheme of this nature has recently been investigated on the Jumna river. It contemplates the development of minimum continuous power of about 1,25,000 kilo-watts in four stages, at places within fifty miles of Saharanpur. The power houses and transmission lines are all proposed to be located in the plains. It is, estimated that, with a 50 per cent load factor, the cost per unit delivered within a hundred miles of the generating stations will be about 1.5 pies. Mr. Meares estimated that a minimum continuous power of 2,40,000 kilo-watts could be generated on the Sutlej within some forty miles of the Jumna generating stations. It appears probable that both these rivers can ensure the generation of an average block of power, amounting to half a million kilo-watts for consumption in the well-populated country between Ludhiana and Aligarh. Saharanpur lies in the centre of this tract, and is one of the best railway centres in Upper India. There is no reason why this tract within economic transmission

distance of Saharanpur should not be highly industrialised if cheap power for electro-process manufactures is made available. It is already attracting industries from outside on account of the Ganges Canal Hydro-Electric Grid, but the power available is at present very limited.

14. I have already referred to the necessity of cheap power for agricultural purposes. An interesting and successful demonstration of this on a large scale is provided by the Ganges Canal Hydro-Electric Grid in the United Provinces. It owed its inception to one of our Past Presidents, Raja Jwala Prasad. The preparation of designs and execution of works were carried out by another distinguished member of this Institution, Sir William Stampe, and the details of the project have been published in his various reports, papers and lectures. Briefly it comprises seven Hydro-Electric generating stations on the falls of the Upper Ganges Canal, the total installed capacity of which is 18,900 kilo-watts, and a steam station at Chandausi, with an installed capacity of 9,000 kilo-watts. The transmission system is 4,525 miles in length and includes 262 sub-stations in urban areas, and 1,662 in rural areas. The connected load is roughly 35,000 kilo-watts distributed as follows :-

For	Industrial purposes	12,000	kW
"	Pumping for irrigation	15,000	"
"	Agricultural processes	3,000	"
"	Domestic and miscellaneous purposes	5,000	"

The pumping load includes power for a system of 1,500 state tube-wells, each yielding 1.2 cusecs on the average, the Ramganga pumped Canal carrying 150 cusecs, the Kali Nadi feeder discharging 100 cusecs, a distributary fed from tubewells carrying about 80 cusecs, and for about 300 private tubewells. All these pumping installations command about 1.6 million acres. Power for agricultural processes is utilised in crushing sugarcane, hulling rice, cotton ginning, oil seed pressing and flour milling, all in rural areas. The total cost of the grid system is about 350 lacs of rupees, one-third of which represents the cost of generating stations. The primary object of the scheme is to help agriculture and develop rural areas. It has been subjected to a great deal of criticism on account of the unorthodox proportion of the length of the transmission system to the power installed. Recently one of the foremost scientific institutes of this country published a paper in which the writer opined that the rural transmission system should not have been constructed, and suggested that the electric installation on tube-wells might even now be replaced by oil engines. I may mention that the sale rate for power is nine pies per unit for irrigation pumping, and one anna per unit for other agricultural processes. The rates for industrial and domestic supplies compare very favourably with those of other electric supply concerns in the country.

The results of the last two years are a complete answer to the critics. In 1938-39 about 700,000 acres were irrigated. The peak load was 21,600 kilo-watts. 73.9 million units were sold which gave a yearly load factor of 39 per cent. The average sale rate per unit was 10.4 pies, and cost of generation and transmission per unit sold and delivered amounted to 7.44 pies. After deducting interest on capital, depreciation and working expenses, a net profit of Rs. 13.88 lacs accrued to the State.

During the current year the peak load has risen to 24,000 kilo-watts and the load factor is likely to rise to 45 per cent. The rate for tube-well pumping has recently been reduced to 8 pies per unit and is likely to be reduced further with increased load factor.

15. Full advantage has not yet been taken of the supply of electricity in about 2,000 villages. Owing to climatic reasons a considerable portion of the power reserved for pumping is available for the development of cottage industries in rural areas, during fairly long periods, when agricultural operations and demand for irrigation are slack. The cultivator can then utilise his spare time in suitable minor industries and suppliment his meagre income. The grid can afford

to sell such power at nominal rates to the advantage of both the State and the cultivator.

16. Gentlemen, I have attempted to place before you my views on the necessity of devoting your attention to some problems, the chief of which is developing cheap water power. I have also indicated the various purposes for which this power can be used for the benefit of the industrialist and the cultivator, besides providing amenities for making life in this country more pleasant than it is at present. A satisfactory advance in civilization needs a balanced progress both in agriculture and in industry. It seems to me that little further progress in any of them is possible without cheap power. Its provision demands serious attention of the State, the capitalist, and the engineer. I am confident that the engineer will contribute his full share in his best professional spirit to the solution of this all important problem.

Khan Bahadur M Abdul Aziz—a Brief Profile

Khan Bahadur Muhammad Abdul Aziz, C.I.E., B.A., C.E., M.I.E., I.S.E. (Retd.), who was President of the Institution for 1939-40, died at his home in West Pakistan on May 22, 1957. He was 73. Khan Bahadur Abdul Aziz was a Member for life of the Institution.

He was born in 1884 in Baghbanpur in Lahore District. He was educated at the Government High School, Montgomery (West Pakistan), and took his B.A. degree of the Allahabad University in 1903 from the M.A.O. College, Aligarh. He passed the Higher Certificate Examination of the Thomason College of Civil Engineering, Roorkee, in 1908. He was appointed to the Indian Service of Engineers as Assistant Engineer in 1909, and promoted to Executive Engineer in 1917. In 1928 he became Under-Secretary to the Government of the United Provinces, and in 1931 he was promoted to Superintending Engineer. He became Chief Engineer, Irrigation Branch, U.P., in 1936 and retired after a conspiciously able career in 1939.

After this retirement from service in the U.P., he held the posts of Chief Engineer, P.W.D., Jammu and Kashmir State, Officer on Special Duty, P.W.D., Bahawalpur State, and Member, Public Services Commission, U.P. He left India in 1947 and settled in West Pakistan.

He took a leading part in the construction of the Hardoi division of the Sarda Canal, the Ganges Canal hydro-electric projects, and many tube-well projects in the U.P.

In recognition of his distinguished services the title of Khan Bahadur was conferred on him in 1928, and some years later he was created a C. I.E.

He joined in the Institution in 1922 as an Associate Member and became a Member in 1932.

A message of condolence and sympathy was sent by the Secretary to Khan Bahadur Abdul Aziz's family on behalf of the Institution. A condolence meeting was held in the Headquarters Office on June 3, 1957, as a mark of respect to his memory.

Mr N V Modak

Esq., B.E., M.Inst.C.E., F.R.San.I.

President 1940-41 & 1941-42

Presidential Address

(1940-41)

GENTLEMEN

In taking office to-day as the newly installed President, my first duty and pleasure is to express to the Members of the Council as well as to other Members of the Institution my sincere appreciation and thanks for the honour conferred on me by electing me to the Presidential Chair.

My pleasure to-day is two-fold, firstly because for the second time in the history of the Institution you have elected a President who is a native of this Presidency, and secondly because the Annual General Meeting is being held in the building, the portals of which I entered about 32 years ago to qualify myself for the career of an Engineer.

I am not forgetful of the many responsibilities and duties attached to this office, but believing as I do, that I have the support, loyalty and good wishes of the members, I look forward to my year of office with pleasurable anticipation. It will be my endeavour during my term of office to walk worthily in the footsteps of my great predecessors-in-office and do my best to further the aims and objects of the Institution.

My next duty is to deliver the Presidential Address. There are two methods which may be adopted in the preparation of the Presidential Address. In the one, the profession which the President represents may be reviewed in general and comprehensive manner; in the other, the address may be limited to the discussion of a few definite points of immediate interest. I am going to depart from both the methods as I propose to devote the first part of my speech to a few points of immediate interest and the second part to the Municipal and Sanitary Engineering with which I have been connected for over 25 years.

We are meeting at a very critical time when practically the whole world is involved in war which started in Europe more than a year ago. The outbreak of the war has opened our eyes to the tremendous potentialities of our country in all kinds of resources both in men and materials, for the successful prosecution of the war.

The war has also given a striking illustration of the exceedingly important role which we engineers play in modern times in the economical and industrial development of a nation. It has brought prominently before the public the fact, that the engineer can play the role of a creator as well as that of a destructor. To-day, public attention has, however, been focussed more on the destructive side due to the recruitment of a large number of engineers and skilled technicians for war work. But the public on such occasions is likely to forget that in time of peace the material prosperity and comfort of the dwellers in practically every quarter of the Globe, are entirely dependent on the activities of the engineering profession represented by the three main branches of Civil, Mechanical and Electrical Engineering.

We cannot fully visualise the consequences of the war at the present moment, the destruction it will cause and the consequent reconstruction the engineering profession would be called upon to make. It is however certain that the world is going to enter upon a new era and upon a different order of things from that to which the people of this world have become accustomed. The disturbances caused in the relations of mankind by the greatest armed conflict which the world has ever seen, will bring into existence new problems for settlement other than those connected with the re-drawing and re-colouring of the political map of the World. It is however certain that the lessons so far learnt are bound to modify the future policy to be adopted by Engineers in respect of housing, town planning, the design and arrangement of public utility services and other important matters. If heavy bombing from air is to be a factor which must be taken into account in planning ahead, some of the methods found satisfactory in peace-time will have to be changed. To take one example, for repelling successfully air attacks, an unfailing water supply is the first essential. A water undertaking of future must therefore be capable of supplying thousands of tons of water required for fire fighting. It should also be in a position to make emergency water supplies available to householders in bombed areas when the mains have been damaged. It must also provide an organization for speeding up repairs of the damaged mains. Similarly, every household may have to be provided with an air raid shelter. The problem of building houses of cheaper materials at lower building costs, will have to be thoroughly gone into if they are going to be demolished by constant air raids. Houses built of cheap materials have become a common feature in Japan and California, where there is an eternal danger of earthquakes. At Quetta, a special kind of RC.C. construction has been adopted to safeguard against damage by earthquakes.

Engineers in the countries at war will be faced with the problem of re-building and re-planning of those parts of large cities which have suffered damage by air raids. The ideal to be followed in the post-war period in such reconstruction must be to create from the ashes and ruins, cities more beautiful and more convenient which of necessity must be greatly different from any yet known. Fortunately for us, we have not yet undergone the horrible ordeal of air bombing, and it is hoped that God Almighty will spare us from any such grim experience.

Besides the change in the outlook in planning of future schemes, we in India shall have to think in advance of an entirely different problem which concerns the engineers and technicians who are at present engaged in war work. Not only is the existing available personnel of the engineering profession used for turning out munitions and supplies for the Armies, Navies and the Air Forces, but as it is found to be insufficient the Government of India have started a scheme of training by intensive course a large number of young men to be skilled workers in Engineering Industries either in India or in the United Kingdom. This step is really advantageous to the country as it will result in the supply of a large number of well trained skilled workers. But if any real and lasting advantage is to accrue to the nation, the knowledge, skill and experience gained by these young men during their war-time training and service must be utilised in increasing the efficiency of our present and prospective engineering industries in the post-war period.

The industrial development of India is happily once again engaging the attention of the Government and leaders of public opinion in this country. It is rather a sad commentary on those who are in responsible positions that it required another war to awaken them to an effort in this direction. It is well known to all of us how the last war (1914-18) was responsible for the setting up of the Industrial Commission which made certain recommendations for the industrial development of India. The inspiration of forming a central organisation for Engineers in this country came from Sir Thomas Holland, the President of the Industrial Commission, and this Institution is the result of that inspiration. The other recommendations of the Commission were however received with indifference for some time, and shelved altogether in the year 1924. This retrogade measure has been fraught with the unfortunate result that we find ourselves in a state of unpreparedness in the event of a national emergency. While we may blame the Government of India for this backward policy, we must also share the blame as some of us honestly think that the introduction of, machine in India should be resisted, and that the people should migrate back from the cities to the villages and there should be greater help rendered to the cottage and village industries. It appears that those who hold this view do not realise that in our country of great distances, cottage and small scale industries, serving local markets, do receive a natural protection, but their development on a large scale can only take place with a proper and adequate system of transport. The problem, of the material progress of India will however be touched on its fringe by the development of only cottage and small-scale industries. Without simultaneous development of the cottage, Key and large-scale industries, India would sink back into the condition of a community of peasants and artisans, from which it started emerging out a century ago. Cottage industries have their own place and should be encouraged by planning them with proper correlation with Key and other large-scale industries.

In planning these industries, "transport facilities" will playa very prominent part. Cheap and adequate transport is the key to the development of industries, and if this facility is not available in a country no industry can flourish. But if we examine the existing transport facilities for our raw materials and finished products, the statistical data reveals our amazing backwardness.

Transport and Communications: The total mileage of metalled and unmetalled roads in British India in 1936-37 was 314,181. Of this 30,293 miles of metalled and 16,534 miles of unmetalled roads were maintained by Government and 52,006 miles of metalled and 215,348 of unmetalled roads by the municipalities and other local authorities.

The total length of railways in India for 1937-38 was 41,076 miles, giving a rate of 117 miles per million inhabitants in the country. The figures available for other countries for 1930-31 are as follows :-

The United States of America, total length 261,816 miles and per million inhabitants 2,132 miles; the United Kingdom 21,162 and 460; Canada 43,173 and 4,318; and Japan 13,363 and 206. Japan, though a mountainous country, surrounded on all sides by the sea and much of its trade is done by shipping, has a larger railway mileage per head of population than India.

The tonnage of shipping entered into, and from the Indian ports during 1937-38 was 21.6 million. The average for three years ending 1937-38 was 19.6 million tons. The corresponding figures for 1937 for other countries were: The United Kingdom 184 million tons, Canada 66 million, the United States of America 146 million and Japan 110 million.

In 1937-38 the number of vessels registered in India was 52 and their tonnage 9,552. As against this, the following figures show the gross tonnage of merchant vessels in other countries :

Name of the Country			Vessels Registered		Year.
			No.	Net Tons.	
United Kingdom	--	--	17,181	10,553,066	1937
U. S. A.	--	--	26,588	14,676,128	1937
Canada	--	--	9,373	1,367,071	1936
Greater Germany	--	--	2,328	4,243,835	1938

Owing to unfair competition and lack of a development policy, there is very little building of merchant vessels going on in India.

The tonnage of shipping entered and cleared at Indian ports stood at 17.4 million in 1913 immediately before the War, and it rose to 19.6 in 1937-38, showing that India has made no progress in overseas travel or communications. In the same period the tonnage in Canada rose from 26.2 to 62.9 million excluding that of the coastal trade, which was 91.4 million.

Taking land transport first, it is seen that railways have had practically a monopoly of internal long-ranged traffic. Recently, as the conditions of the roads have greatly improved, motor vehicles have come into the field and in many cases are challenging this monopoly, although railways must continue to be the main carriers of heavy goods. The advent of the motor vehicles has opened up new possibilities of communication to the villages scattered all over the country, and has undoubtedly given an impetus to trade and commerce. Cheap motor transport has to a great extent eliminated the wide fluctuations that existed in different parts of the country, in prices of raw materials and finished products. It would be quite unwise to suppose that the rail and the road should compete with each other for supremacy. In a country like India, there is a sufficient scope for both the rail and the road traffic. Instead of being a competitor, road traffic has proved a complementary source to the rail roads in many cases. One of the defects of road transport often pointed out, is that there is no organised effort for its operation. The competition is generally carried on by buses and trucks operated by individual owners, there being very few large transport companies in India. This system undoubtedly has certain advantages, as it is more elastic and can more effectively cater for the individual needs of the customer. Organised transport companies are not altogether wanting; the Gwalior and North Transport Co. and the Nizam's State Railways afford two examples of controlled road transport, designed to act in a supplementary capacity to the railways, with mutually satisfactory results. There is a striking advance in air traffic in India since the end of the Great War. Aero clubs have been started in a few important cities and towns making the civilian population air minded. India is an important link in the world's air communications since the inception of Imperial Airways Services from London to Australia and Hongkong; the K. L. M. Airways serving between Amsterdam and Batavia ; and "Air France" with a service between Paris to Saigon. Apart from these foreign services, there are a number of domestic services now operating :-Delhi-Karachi (688 miles), Delhi-Bombay (861 miles) operated by the Indian National Airways ; Karachi-Colombo (l,880 miles) operated by the Tata Airways; Bombay-Porbunder operated by the Air Services of India.

The development of domestic air-lines has been slow. The greatest obstacle to rapid development is the inadequate number of aerodromes, and before a new service can be established a great deal of time, money and effort has to be spent on ground organization. The Government of India have sanctioned a scheme to develop aviation in India involving an expenditure of two crores of rupees. Part of this sum is intended to be spent on improving existing aerodromes in Northern India ; but a large portion will be devoted to the construction of a new aerodrome on the Bombay-Cochin and the Bombay- Calcutta Roads. This marks a big advance in India's Air Communications.

Shipping transport plays a vital part in the development of commerce and industry in a country. India has a long coast line and many other geographical advantages, but the number of ports with accommodation and facilities for ships alongside quays, is surprisingly small. India once carried her merchandise to other countries in Indian ships. At present there is no shipping worth the name in India, and even the coastal trade is not carried out by Indian-owned vessels. The question of training of Indians as officers and engineers in seagoing vessels has not received the attention that it deserves. The Government have not visualised the necessity and ultimate advantages of having an up-to-date mercantile marine and an Indian Navy in Indian waters. The provision of the training ship Dufferin is a solitary instance of Government's support in this direction. It is a matter for regret however that the officers turned out by the training ship Dufferin are not given suitable berths on ships owned by foreign companies. It is hoped that things would improve and in course of time the officers trained on this ship will be engaged by all the companies plying their vessels in Indian waters.

Though India has got over 55,000 miles of water-way, there has not been much advance in the direction of inland water-way transport due to the difficulty to navigation by swift currents, hidden sand bars and other hazards. Similarly, water-way transport through irrigation canals has not been developed in the past in spite of the extension of irrigation works throughout the country, and it may be necessary in the near future to explore the possibility of this form of transport for the carriage of agriculture and forest produce.

Having drawn your attention to the important matters arising out of War conditions. I now proceed to take stock of the work done by our Institution during the past 20 years of its existence with a view to ascertain how far it meets the needs of the profession and what improvements can be made to increase both its utility and strength. The Institution has attained majority this year. It is also more than 5 years since it has been privileged with the award of a Royal Charter.

To judge the work already done by the Institution we must see to what extent the aims and objects with which the Institution was started have been attained. It would be impossible for me to deal adequately with all the objects set out in the constitution. I shall therefore choose only those objects which to my mind are the most important. The Institution was started with the object of promoting and advancing the science. practice and business of Engineering in India and elsewhere. and another object of the Institution was to give the Government, the Local Governments. the Municipalities and other public bodies and others. facilities for conferring with and ascertaining the views of the Engineers as regards matters directly or indirectly affecting engineering. and to confer with the said Governments. the Municipalities and other public bodies and others. in regard to all matters affecting engineering.

If we take a review of the last 20 years, we shall have to admit that although the Government of India. the various Provincial Governments and other public bodies have consulted the Institution with regard to certain matters and the representatives of the Institution have been asked to sit on certain Committees directly or indirectly connected with engineering. our record in this matter is not such as we could be proud of. To take a recent instance, the Government of India have considered the question of training technicians as skilled workers for the War industries. Our Institution did not find a place in the deliberations that took place for devising ways. means and methods. I do not wish to blame the Government of India for this omission: I would rather blame the Institution itself. The importance and status that any institution like ours achieves is in general directly proportional to the service that it renders to members of its profession and to the public in general. We have, in my opinion, failed to achieve this importance and status on account of insufficient activities on our part and probably an unhealthy rivalry that appears to have developed in creating a Provincial feeling and seeking to gain a greater advantage for a particular Province rather than serving the true interests of the Institution. Perhaps this feeling may be a reflection of a similar feeling in the political sphere. Unless we are united, there is no likelihood of the influence of our Institution being felt by the Provincial as well as the Central Government. I would therefore appeal to all the members to sink their differences, if there be any, and to give the best in them to raise the status of the Institution in the eyes of the Central and Provincial Governments.

There also appears to be some misunderstanding in the minds of Engineers holding responsible positions under Provincial and Central Governments who have not yet joined our Institution and this misunderstanding is likely to be removed if we are able to make our voice heard both in the Provincial and Central Governments.

Another important object with which the Institution was started was to see that the young Engineers in this country receive a sound theoretical and practical training and that a high standard of education is maintained by engineering schools and colleges in India. I do not think that we have made much advance in this direction and I am not aware of our Institution having either moved in this matter or having been given representation in the Universities or Engineering and Technical Institutions to help in the guidance of engineering education. We must therefore approach all the Universities, Engineering colleges and institutions in India, and request them to give our Institution representation on their committees for guiding engineering education.

There are two major problems connected with the education of Engineers. The first is the method of imparting education, and the other is the employment of the Engineer after he has been properly trained. The education imparted must be such as to make the Engineer sufficiently competent to follow his chosen profession either independently or in service. In the latter case he must prove useful to his employers, whether they be the Government departments of Public Works and Irrigation or Private Bodies comprising all branches of engineering. Both these problems are very closely inter-related; because although there are quite a number of young Engineers who after their training fail to obtain suitable employment, it is very often stated that there are no suitably trained Indians to occupy positions of responsibility in Engineering Industries, in Munition Factories, etc. Lieut.-General Sir Edwin Atkinson in his Presidential Address of 1930 to this Institution, declared for example that although he was very keen on Indianisation in the Army Factories in the grades of foremen and chargemen, and for which men had at that time to be specially brought from England, he was very greatly handicapped because real knowledge of the manufacture of lethal weapons and Army equipment could only be obtained in the Home country. Examples of utterances of this type could be multiplied very easily, all of which only show that it is imperative that something should be done about the method of technological training in this country. If our industries are to work efficiently and prosperously and if the supervising, and directing staff required for these industries is to be recruited from trained Engineers who are born and bred in this country, it is highly important that the technical knowledge requisite for such duties should be made available in this country.

The introduction of Engineering education in this co-untry was in the early days primarily due to the needs of the Government Departments of Public Works and Irrigation, and education therefore in the early days was confined only to one branch of Engineering, viz., the Civil Engineering as differentiated from Military-Engineering. In those days the Government services used to absorb nearly the whole of the output of the Engineering Colleges, and any surplus used to find employment in trades and the industries. The fact that the Government used to absorb the majority of the graduates, led to the undesirable tradition of service mentality among the Engineering students, and traditions once formed die slowly. In recent years education in other branches of Engineering, notably in Mechanical and Electrical

Engineering, is being imparted in Engineering Colleges, and the Engineering trades and industries, rather than fhe Government, are absorbing more and more of our Engineering graduates.

It is therefore necessary that the training imparted in the Engineering Colleges should be such that it would meet not only the needs of the Government Departments but also those of the trades and industries. The courses in the Colleges should be moulded as far as possible in accordance with the above requirements and the practical training should also follow suit.

When we speak of education for Engineers, we should not confine our attention only to the education of those who would ultimately be in the supervising and directing positions, but we should also think of the education of those who would be in subordinate positions and the education of the skilled workers or artificers.

The question of education and training of the Engineering students on the technical side has been so fully discussed in recent years that there is very little that is left unsaid on the broad aspects of the subj ect. Undoubtedly, the ideal method of teaching engineering would be to give the instruction in the theory and practice simultaneously. In England, an attempt has been made to achieve this ideal by the introduction of the "Sandwich System." In this system the student has generally to undergo a course of 4 years. In the first 3 years, the first six months of every session are spent in the workshops to learn practical work, and the remaining six months of the year are spent in the University for receiving theoretical training. In the 4th year the apprentice is given practical training in a more advanced department, usually test bed, drawing office, or other technical departments, thereby giving a final touch to his practical training.

One of the defects of the "Sandwich System" is that there is too great a lapse of time between the theoretical and the practical training periods. A more harmonious synthesis is sought to be attained by the "Co-operative System" which is but a highly developed form of the "Sandwich System," followed in the United States of America.

Under this system, the courses are so arranged that the students spend first one week at the works of a manufacturing undertaking and the next week in the college ; this weekly alternation of practical and theoretical work being kept up during the whole period of the engineering course. The courses are arranged in such a way that the practical problems arising in a workshop are dealt with from the theoretical standpoint in the classroom immediately in the succeeding week. That is to say, the theoretical instruction is planned with a view to helping a student to accomplish his practical task more quickly and efficiently and at the same time with a more perfect understanding. The cost of the “Co-operative System" is comparatively high. The education and training provided under this system is on a very broad basis and adds greatly to the value and completeness of the student's knowledge of both the practice and the theory o.f engineering.

The adoption of any particular system will depend upon the conditions obtained in the various parts of this country, and more particularly upon the amount of co-operation that can be obtained from the industry for the practical training of the student. Looking to the location of various engineering institutions in this country it appears that it will not be possible to adopt the “Co-operative System" but the adoption of the "Sandwich System" would be possible with the co-operation of the Industry. Many industrial firms and engineering workshops are appreciative of the value of such co-operation, and some manufacturing firms have adopted a policy of receiving as pupils, young men who have been suitably educated for the engineering, profession into their workshops without the payment of a premium. These firms provide a systematic course of training under careful and strict supervision for these pupils in their workshops. One instance of such a firm is the Tata's Iron & Steel Works at Jamshedpur. Some firms, who have also an organised system for practical training, charge a premium for taking in students as apprentices. The Bombay Electric Supply & Tramways Co., who have a very well-organised course, fall in the latter category. Thirdly, there are firms who have not yet opened their doors for the training of apprentices. The last in my opinion is a suicidal policy, for if any industry is to continue to thrive and to prosper, there must be a constant inflow of skilled men to take the places of those who leave or retire. If any industry is not prepared to do its part for the training of such men, it is either depending on someone else to do that work for her or is merely depending upon chance to get the necessary resources in trained men.

It would be better if the firms which are taking in students with the payment of premiums, begin to admit them without any premium whatsoever, for the Engineering profession, if it is to thrive, must get its recruits from the best young men whether rich or poor and should not be restricted only to such of them as are able to pay the premiums.

Mr. Jwala Prasad, in his Presidential Address before this Institution in 1932, suggested the formation of an All-India Engineering and Industrial University wherein all the Engineering and Industrial courses should co-operate in training the youth for the material and economical uplift of our country. He further said "We may be good irrigation, building or railway engineers but we are yet far behind in other important branches such as marine, agricultural, aerial, military, electrical and mechanical engineering." I entirely agree with the view taken by Mr. Jwala Prasad, but I would add a few more branches of engineering, such as architecture, harbour, shipbuilding and automobile engineering to the list given by him. Although the launching of an Engineering University would be an ambitious plan at the present moment, I venture to think that the time is now ripe for the establishment of well-equipped Engineering Colleges in the various Provinces, wherein instructions may be given in architectural, marine and structural engineering in the initial stages, and the other departments of engineering mentioned above may be added at a later stage.

Looking to the facilities available in the Province of Bombay for the purpose of introducing engineering education on the "Co-operative System," it appears that the proper place for the starting of a new college would be the City of Bombay. I do not wish to cast any slur or reflection on the College of Engineering, Poona, as in my opening remarks I have already told you that I myself am a past-student of this College. I however must confess that the Poona College is not situated in a proper industrial environment which is essential for the introduction of the "Co-operative System" of education. It must also be remembered that additional courses of study, such as architectural, automobile engineering, etc. are not likely to be introduced in this College in the near future, as they would involve large financial commitments which would not be justified on account of lack of industrial environment. On the other hand, there are a number of engineering firms in Bombay who can provide the required practical training to the students taking up the additional courses. Bombay has also a number of mechanical engineering workshops, and engineering industries, a number of cotton mills, in which mechanical and electrical engineers would find a great scope. The Bombay Port Trust and the Dockyards can give great facilities for the training of Marine and Ship-building Engineers and the Workshops of the two great Railways, the G. I. P. and the B. B. & C. I., may be used with advantage for practical training. It would however be difficult for any private body to start a new college in Bombay, without having a nucleus of the nature now available in Poona in respect of buildings, equipment, staff and financial aid. If these facilities were made available by Government in Bombay even at the risk of shifting the existing College from Poona to Bombay, a properly constituted educational body may come forward to take over the conduct of the college for the purpose of widening its utility by initiating courses in other branches of engineering for which there is a great need.

It is the experience of educationists connected with engineering education that most of the candidates seeking admission to engineering colleges are not really fitted for the profession of an engineer. This happens in most cases because firstly the candidates are not caught at a sufficiently young age when they may have shown an aptitude or a bent towards engineering.

Many young men in this country take to the engineering profession not because they like it but because someone has told them that the engineering profession offers good prospects. In my opinion the education of an engineer really starts from his childhood. I would like to emphasize that Kindergarten as a branch of the primary education has been sadly neglected in this country. The child, who while playing with his toys has learnt to tighten a nut without spoiling the thread, has made more progress in his engineering education than some mechanics ever do, and sympathetic teachers in the Kindergarten stage can assist greatly in finding out whether the child has got the engineering bent or not. I should therefore suggest that in making the selection of candidates for engineering colleges more emphasis should be laid on the aptitude for engineering than on mere academic merit. It is also desirable that the candidates should be taken in for the engineering course at the earlier stage of their academic life, preferably that of matriculation. If the system of education in this country is overhauled on the lines of bifurcation in the schools, so that boys having engineering bent can begin to take their initial lessons in mechanics and know how to use their hands while they are at schools, a great improvement will result in the engineering and the technical education. Efforts in this direction are being made by the Government of Bombay who have started one or two engineering bias schools in the Province. With the growth of such schools, the selection of candidates for engineering and technical education, both for the higher grade and intermediate grade, would be comparatively easy.

Before I conclude, I should like to make a few remarks about Public Health and Municipal Engineering. Municipal Engineering has made a remarkable progress in the last decade in Western Countries, and one of the most outstanding features towards the improvement of the health of the people is the sanitary provisions and the disposal of sewage. This has resulted in a decided improvement in the living accommodation of the people and the abolition of some of the filthy slums.

Unfortunately this branch of Engineering has not made any appreciable progress in this country, as its development is entirely dependent upon the interest taken by the elected representatives of Local Bodies and funds at their disposal. Though Local Government is the first line of defence thrown up by the community against common enemies, such as poverty, sickness, ignorance, isolation and social mal-adjustments, and touches the everyday life of a citizen, it has not developed sufficiently well in our country and there is no marked advance in our towns and cities in those services which affect the health and well-being of the community. In large cities, however, there has been an awakening of civic sense in the minds .of the citizens, and due to this there is a cry for more service, better service and for service that costs more money.

The financial needs of large cities in India have been increasing more rapidly than their population, their wealth and their income from the usual sources. Larger the city population, greater is the per capita cost of serving the population as the cost of service varies directly with the density of population. More industries and increase in population make the financial problems of the city more difficult. Due to poverty, our urban population has already been heavily taxed and it cannot shoulder the burden of additional taxation by a local authority. In Western Countries, the rates levied by local authorities are very high. In Great Britain, they vary from 10s. to 15s. in the pound. This means that each individual rate-payer living in a house of rateable value of £25 per annum pays a total sum of £12-10-0 to £15 in rates for the service given to him by the local authority.

If schemes of improving environments are to be launched by local authorities without substantial increase in the present taxation, the best talent in the profession will be required and the Municipal service will have to be made more attractive in respect of salary and status of the Municipal Engineer. Unfortunately, the local authorities now-a-days expect much from their Engineers while offering so little. Without in any way encroaching upon the rights of a local authority in the matter of selection of a Municipal Engineer, I venture to suggest that there should be a central organisation perferably on the lines of the Public Service Commission, for the selection of a suitable person for the appointment of a Municipal Engineer, and Government should see their way to undertake legislation so as to implement this suggestion.

During recent years, changes have occurred which have compelled the Municipal Engineer to change his outlook in many respects. This change of outlook has nowhere been more marked than it is in regard to the important subjects of water supply, sewerage and sewage disposal housing, town planning, etc. They are receiving broad and far-sighted treatment at the Municipal Engineer's hands, and he is required to use skill, vision and courage in their design. He has to look not only to the present requirements but also has to plan ahead for the future. He finds however especially in dealing with improvements in large cities that for want of adequate legislation he is powerless to effect improvements at modest cost within a reasonable time. He is also confronted with the problem of how to successfully counteract the opposition of individual landlords who do not like restrictions being placed by a local authority on the method of development of their lands in their own way when the local authority contemplates undertaking a development scheme for the locality in the interest of health, amenity and general well-being of the community. It must be brought home to the land-owners that in any civilised country, private rights must cease when they become public wrongs. It is therefore necessary that land which is the ultimate source of wealth, should have its regulations as stringent as many other things when the health of the people is concerned. The law regarding its use should be for the greatest good of the greatest number.

Similarly, local authorities of large cities must be given power for acquiring lands for parking of cars. The problem of parking cars is getting every day more difficult in large cities, especially in business centres, and unless planning is done ahead in this respect, the problem will be still more difficult in the near future. It is also necessary in triis connection to give powers to local authorities of large cities to compel cinema theatres, places of public amusement and also places of public assembly, to provide parking spaces of their own for their patrons use.

Road making in the city is very closely linked with town planning. The present roads of our large cities are found to be inadequate to cope with the traffic passing over them. We are, therefore, confronted with a serious difficulty in fixing the widths of new streets as the same may be found to be too inadequate in course of time. We, engineers, must take courage and should arrange layout schemes reserving large areas of ground for future widening, though they may not appear to be required to-day and hence non-utilitarian and visionary. Many of the schemes are visionary in the initial stage but they become realities when adequate funds are available.

Another important problem in connection with road making is the safety of the users and reduction in the death toll due to accidents. This can only be got over by the segregation of traffic, especially the heavy class, to specified routes. The time has now come particularly in large cities when the unrestricted use of the roads by cyclists must be checked in the interest of cyclists themselves. They should have tracks of their own. A large number of accidents, occur at road crossings and this problem must be tackled first. The roundabout system is being exploited in large cities and shows signs of success, but it cannot be quite successful and safe unless the cross traffic is totally removed.

Something needs to be done regarding Ribbon Development. Everyone will, I think, appreciate the extent to which the amenities are being destroyed by the conversion of rural roads into semi-urban streets, thereby making the roads unsafe for all users of roads. This requires very careful consideration at the hands of the Local Government, and some legislation to put a stop to this kind of development is necessary.

Large cities all over the world are confronted with the problem of Housing and Slum clearance. The modern housing problem is rooted in the Industrial Revolution. In the last Century the industrialisation of towns and cities very rapidly increased the urban population. For example, in Great Britain, between 1821 and 1936 the country dwellers decreased from 10 to $9^1/_2$ million while the town dwellers increased from 4 to 37 million. The figures for Germany for the same period show that the country population dwindled from 23 to 19 million, while the town population rose from 2 to 48 million. When the population increased, dwellings had to be erected to accommodate the workmen within walking distances of the centres of work, and this led to the creation of bad housing. The slum problem of to-day is therefore the inheritance of a century or more when building was not subject to any degree of supervision or control.

For the prevention of "New Slums", effective control over the erection of new buildings is essential and this can only be secured by framing stringent Building Code for each city and enforcing the same with vigilance. Except for a few large towns in India, Building Bye-laws are not in existence, and where they exist they are out of date as regards open spaces, etc. It is therefore suggested that large cities should revise their existing Building Codes with a view to bring them up-todate and to suit the modern trend of living. For the eradication of existing slums, additional powers on the lines of the Housing Act (1936) of the British Isles should be obtained by local authorities so as to enable them to effect the removal of slums in reasonable time with moderate cost. Legislation alone will, however, not be helpful as the funds at the disposal of a local authority may not be sufficient to undertake this kind of work. In Western Countries, the slum problem comprised of three items — (1) how to make up the shortage of houses due to under-building, (2) how to prevent recurrence of shortage by organising regular supply of new dwellings sufficient to house the new increase in population, and (3) how to demolish and replace the worn out or unhealthy parts of the cities in accordance with modern needs without destroying historically or aesthetically valuable buildings in the areas to be improved. Each Government is trying to solve this problem by finding its own cure and the whole burden thereof in those countries is not thrown on the local authority. What is therefore wanted is a properly thought out and pre-conceived "Master Plan" for every large city. This plan should show how the city should be remodelled and extended as regards industry, residential areas, places of amusement, educational institutions, open spaces, parks and playgrounds for health and recreation of citizens and physical development of youth. To achieve this end, the city will have to be divided into suitable zones so as to fix the dimensions of the open spaces to be left round the buildings and their heights according to their users. So far, no large city in India has yet obtained powers regarding "Zoning" which is essential for a proper development of the city. It may take years before the city is able to develop itself according to the "Master Plan" but development without a pre-conceived plan is always costly in the end and looking ahead saves large amount of money to the local authority.

With regard to sewage disposal, every local authority must solve its own problem after taking into consideration the character of sewage, the nature of trade wastes, and other incidental local factors. The system of purification employed must be such as would suit the purse of the local authority. It must be borne in mind that a highly scientific system of sewage purification dependent on highly skilled control, however useful in a large town, is dangerous in a small town where constant skilled control is not available. A simpler system of sewage purification will therefore serve better a small town than a highly efficient system requiring skilled supervision.

It is desirable that Local Authorities and Government should encourage and subsidise research and investigation in connection with sewage disposal and allied problems. Encouragement in this respect has so far not been received on the score of expense. Due to this, too little opportunity is given for the solution of problems to the man on the spot and his enthusiasm and thirst for knowledge are discouraged and stultified. If the local man on the spot were given the necessary encouragement for carrying out the investigations to suit the requirements of the locality, he should be able to solve the problem at a less cost to the local authority than the fees paid to, and the works suggested by the consultant who, not being on the spot, is not likely to know much about the problem and is not therefore in a position to indicate the solution of the problem at the least possible cost. This statement is not only applicable to sewage disposal problem but also to those of water purification, refuse destruction, etc.; for example, the Hugh water is laden with iron oxide fine silt, while Ganges water is clear, each requiring observation over a long period by the man on he spot.

Coming now to the Municipal Engineer himself, his position to-day, as pointed out previously, is not happy. He has not infrequently to regret that a solution or step recommended by him as proper and fitting is delayed or abandoned for some reason or the other. He should not however get discouraged but should try to steadily put forth his point of view on every possible occasion, and this he can only do if he were able to write an intelligent report explaining in concise and logical order the details of the case entrusted to him. However good and accurate an engineer may be, he will not succeed unless he knows thoroughly well how to present his facts. His first and foremost consideration should be the good of the locality and he should exert his influence with the Council to secure this end. As a public official, he is in the public eye, and naturally he is subject to criticism both just and unjust. Here he should develop the quality of not being too sensitive and should take no heed of the unjust criticism so long as he is carrying out his duties loyally, faithfully and to the best of his ability as per policy enunciated by the local authority under which he is serving and so long as his character and integrity are of high order.

In brief "he must have the patience of Job, the tranquility of an Archangel, the tact of a diplomat, the firmness of a dictator and the ability to meet emergencies and disasters with the spirit of Mark Tapley." .

Gentlemen, I have done. Before I sit down I must thank again the Members of the Council for having elected me to this Chair and to you all for having listened patiently to my rather lengthy address.

Presidential Address

(1941-42)

GENTLEMEN,

I thank the Council most sincerely for my re-election as your President for another year and am keenly appreciative of the confidence this action implies. The responsibility thrown on me appears almost overwhelming due to the peculiarly critical times through which we are passing at present and to the difficulty experienced in the proper conduct of the affairs of the Institution owing to multifarious and often divergent interests. I however assure you that I shall endeavour to discharge the onerous duties that have devolved upon me to the best of my ability with your co-operation and forbearance.

It is customary in professional Institutions like ours that a President if re-elected to the office is not expected to deliver a second address. This convention may have originated probably due to considerations for the President or probably as a measure of relief to members. In our Institution this is the first occasion that a President is re-elected for a second term of office, and I have no convention to go by. I therefore propose with your acquiescence to elaborate on a few points from my address a year ago.

The present time is the most momentous in the history of the Empire and that of our Country. When I addressed you on the last occasion the theatre of war had not spread so far and wide, as it has to-day. It has not only spread over five Continents and the seven Seas but has come to our very doors. We have incurred new enemies and have secured new and powerful friends whose accession to the Allied cause is a guarantee of ultimate victory. It is gratifying that India's armies have distinguished themselves on the various fronts and have proved that in fighting power they are second to none. I therefore pay my warmest tribute to the val our by which they have upheld the traditions of our' Country.

In modern warfare which is highly mechanized it is but natural that 'engineering' in almost all its branches should playa most important part in the prosecution of the war, and naturally the talent, experience and energies of engineers trained in the high standards of their profession are greatly in demand. It is true that the Indian engineers have not the same opportunities to play their part in the active services — in the Navy, the Army and the Air Force — as their professional brethren in other parts of the Empire. There are however other fields in which their technical knowledge and skill are needed and that is in the vast organization engaged in the preparation and production of the needs of the fighting services. The production of adequate supplies of high precision standard requires a sustained effort both in the design and manufacture to a high degree of accuracy and reliability. New personnel has to be trained in the methods of precision work for the manufacture of unprecedented quantities of these materials. Ammunition factories, arsenals and depots have to be extended to double or three times their size, and transport facilities and housing have also to be provided on an unprecedented scale. It should be remembered that ultimate victory may depend as much upon our capacity to produce reliable material of satisfactory quality and in sufficient quantity and therefore on the skill of those engineers who are engaged in the production of war material, as on the valour of those on active service. Victory, if we reach it, as we confidently trust we shall, will largely be the result of the general progress achieved through the concurrent exertions of all Engineers, civilian and military, constituting the main branches of engineering represented by this Institution. What Mr. Lloyd George said regarding the last World War, viz., "that this is an engineer's war, for equipment was even more needed than men", is even more true to-day.

The present war is being carried on on very different lines to the last. It is nothing else but brute force and misuse of science. Engineering appliances meant for promotion of human welfare have been converted into weapons of destruction. The internal combustion engine is, for example, playing a murderous part of destruction on unprecedented scale. Its inventors must never have imagined that their invention would be used for the purpose of driving machines employed to carry by air high explosives for the destruction of helpless women and children or to carry poisonous gas or to injure and suffocate the civil population of any country. It must however be pointed out that it is not the mechanical apparatus, in this case the internal combustion engine, which is wicked or even the man who invented it. The plain fact is that man's discoveries and material progress have outrun his moral growth and till he grows in his moral stature and learns better ways of life he will continue to be a danger to himself and to his neighbours.

Our immediate problem however is to tackle this evil that is around us and to devise ways and means to minimise the effects of destruction which the 'Messerschmidts' and other death-dealing planes cause on civil population. This brings us to the important role which the engineer has to play in civil defence and in the protection of civil population from air raids. The essentials of air defence are bomb-proof shelters, structures that would resist and recover from air raids, and services the supply of which is immune to dislocation. This work which had to be attended to by those who have not the opportunity of active service constitutes an essential part of the war service, as it is owed to those at the front that they should feel confident that their families and homes would be given all possible protection from the horrors of war.

Supplies for war purposes have led to increased production in industries which were already well established and have also given an opportunity for the establishment of such industries necessary for the production of essential war materials. It is however still true that the development of industries in India does not compare favour ably with that of other industrially advanced countries, and that this country is still lacking in the basic and key industries, occupying a very low position in the Industrial world. India has yet to build a sound industrial structure. The capital invested in industrial establishments in India is only 700 crores of rupees against that of 25,000 crores and 7,000 crores invested in U.S.A. and Great Britain respectively. In spite of this handicap, large scale supplies have been made by this country to all the theatres of war, in the Middle East, Persia and Far East, to the value of about 164 crores of rupees during the last two years.

The impetus given to indigenous industries by the war is only temporary and the advantage gained by industries during artificial war conditions will not last during peace time unless the industries make the best of their opportunities gained during war-time and the State gives the newly established industries adequate protection against foreign competition. The State is at the present juncture making a survey of the country to find out what war materials could be manufactured in this country. It is necessary in the best interests of this country that full advantage should be taken at this stage of this country's natural resources, its position to supply the demands of the countries in the eastern hemisphere, and the establishment of new industries. The most serious handicap in the expansion of Indian industries is the difficulty of obtaining machinery, machine tools and many of the raw materials necessary for manufacture. It is therefore hoped that at the end of the war this drawback will be removed and India will soon develop on a very large scale basic industries of engineering, machine tools, power and transport. A survey of the natural resources of India for the establishment of various industries on a planned basis had been undertaken by the 'National Planning Committee' and it had obtained the co-operation of scientists, engineers, the Provincial Governments and professional bodies. It is desirable that the valuable information collected by the various committees should be made available to the public at the earliest possible date.

In the development of our industries an important problem that we, engineers, will have to face during and after the war is that of labour. I am aware that the problem is too vast, complicated and controversial to be entered into details on this occasion ; but I have mentioned it because it is one of the greatest problems that we shall have to face. The labour at present seems to think that they have only rights and no duties. It will have to be educated to realize that they have duties as well as rights. Only after such realization the labour will take an intelligent interest in his work and in its development. The employers and the employed must try to understand and trust one another in working together for the common good of the country. The employers will also have to learn that they themselves must do what they enjoin on their employees. The employer must get himself acquainted with the conditions of life and view-point of the employee and he must see that while asking the employee to deal fairly with him he himself sets the example of fairness. Unless there is mutual regard and trust between the employer and the employee, no improvement in the relations of labour would take place. It is the duty of the employer to decently house, clothe and feed the employee and to see that he is shielded from coercion by other fellowmen which has a tendency to reduce efficiency.

When we speak of industrial development, we must bear in mind that the present age is of scientific progress. Today, to be reckoned as a great and prosperous Nation implies that we must be at the forefront in scientific genius, in engineering capacity and in the capability of harnessing the immeasurable forces of Nature for the benefit and convenience of mankind. India has incalculable natural resources but they have not yet been harnessed for the use of our country on a sufficiently large scale. I do not propose to dwell on the reasons of our backwardness in this respect as these are a matter of common knowledge. I only wish to indicate here one of the essentials in engineering education which has been so far almost neglected in this country, namely, the provision of research laboratories for the pursuit of engineering research. Very small facilities exist in our engineering colleges for this purpose. It is necessary that these facilities should be extended to a very great extent as it is only before entering a profession that a young engineer has got the best opportunity to study a subject on purely academic lines. Scientific research on purely academic lines should be closely pursued, for it is very often from this kind of research that many of the most lucrative industrial developments have arisen. If post-graduate research departments were instituted in various engineering colleges in this country, we would have in the professors who would guide the research and in the students who would actually carry out the experimental work, a very large personnel available for such work, and with planned organization it would be possible to bring the research workers and the manufacturers in close contact and thereby help to keep the needs of the industries constantly before the eyes of the research workers. It should be also stated here that inspired education can be given only by those teachers who are themselves actively engaged in the investigation of some problem, and the establishment of post-graduate courses in our engineering colleges would have a greatly beneficial effect in our engineering education.

While I am still on the theme of technical and engineering education, I may state that in this sphere an Association of Principals of Technical Institutions has been recently formed with the following objects:—

(1) Co-ordinating technical education in India.

(2) To draw a national policy in Technical Education with the help and co-operation of the Central and Provincial Governments, Indian States and the Industries.

It is felt that the War, on account of the impetus it has given to the demand for skilled men, has created a good opportunity for pressing the claims of technical education. The Association, I understand, has also before it for consideration the problem of the absorption of the skilled or semi-skilled workers, which would be available at the termination of the War. A nucleus of the skilled and semi-skilled workers is considered as an essential requisite for the industrial expansion and prosperity of this country, and the availability of trained personnel, it is hoped, will break down the vicious circle. It is realized by the Heads of Training Centres that a large number of men trained for munition productions would require "reconditioning" to facilitate their absorption into industry under the conditions then obtaining according to their inclination and ability. This would necessarily mean that the training centres which have now been opened up for the training of War purposes would have to be continued for a further period in order to make War trainees useful in peace-time occupations, and I am glad to learn that the Government has already sanctioned the continuation of training at the training centres for a period of 18 months after the termination of the War.

The most important problem to which the Association of Principals of Technical Institutions has devoted its attention is the co-ordination of Technical Education in India.

In this effort of co-ordination it is hoped to bring about a closer linking of the school, the Technical Institute and the Industry.

I had in my address, last year, stressed the importance of adopting a new system of secondary education for those who wish to go in for Technical Education. For the satisfaction of the Industrial needs of this country, I feel that side by side with the University Education with emphasis on post-graduate research, there should be a simultaneous growth of Poly-technics. I know that the University product is looked upon with greater favour but there are certain requirements of Industry for which the Poly-technic product is definitely more suited. To put it in a nutshell one may say that the University on the whole turns out a more academic article than the Polytechnic with the result that the former leans towards research and the latter towards managerial posts in Industry. For the requirements of the Industry, both these types are needed in addition to the Foremen type. I may say that we have to train three types of students, viz., (1) the Foreman type, (2) The Managerial type and (3) The Research type. Each of these groups should undergo its particular type of education and have its own type of qualifying examination and award and each in its own group should be nation-wide in character and value.

While dealing with Technical Education it is necessary to remember that there are three partners in the Scheme. The School from which the boy comes, the Technical Institute itself where the boy is trained in the particular technical branch and the industry to which he will ultimately go after finishing his education. For a well organized and well planned system of education it is therefore necessary to see that collaboration between all these three partners, particularly so between the Technical Institution and the Industry, is assured. As a result of such a collaboration, the most interesting and important development in Technical Education came about in 1921 in the United Kingdom, namely, the award of National Certificates by the Board of Education acting in co-operation with professional Institutions. The Association of Principals of Technical Institutions have, I understand, appointed a sub-committee on which our Institution is represented, and that the Committee's recommendations will come before the General Meeting in a short time. The essential principle in the award of National Certificate is the insistence of a common standard, which need not necessarily mean common examination.

We all know that in a large country like India we have several Technical Institutions, the Certificates and Diplomas of which are valued only within a limited territory. These institutions have their own standard and they award Certificates and Diplomas on their own examinations. Under these circumstances the employer has to compare and weigh the merits of Diplomas qua Diplomas and Certificates qua Certificates. Thus if an employer in Bombay has before him candidates with degrees and diplomas awarded at Benares, Calcutta or Madras, he has under the present circumstances to weigh up the value of the respective degrees, etc., which disadvantage would disappear with the adoption of a common standard. A man in Delhi if he wants to employ a Foreman who received theoretical part of his training at Bombay, should be able to call for a certificate which would be as well-known and have as much value there as in Bombay. In other words, he should be entitled to a 'National' by which I mean a Certificate of 'all India' value.

It must be emphasized here that the adoption of a common standard does not necessarily mean a common examination and identical syllabi. It is realized that the conditions of Bombay will be different from those of Madras and therefore courses which are suitable in Bombay would be unsuitable for Madras, But even with the diversity in the syllabuses it has been demonstrated in the United Kingdom that a cornman standard can be adopted and I believe that the Association of Principals of Technical Institutions have the same object in view. In England the award of National Certificates was first undertaken jointly by the Board of Education and Institution of Mechanical Engineers to the students of Technical Schools who had satisfied certain conditions upon which the two co-operating bodies had formerly agreed. As the Scheme proved successful it was followed by other professional institutions such as the Institute of Chemistry, the Institute of Builders, the Institute of Naval Architects, and the Institution of Electrical Engineers. Recently the Textile Institute has been added to the list for the award of National Certificates for Textile Industry.

I will not go into details regarding the working of the Scheme of the National Certificates and Diplomas but the working of these for the last 20 years in Great Britain has proved that it exercises a healthy influence in the provision and conduct of education in Technical Schools in those branches in which the system of national certificates has been adopted. In the first place the adoption of national certificates scheme has led to the introduction over a very wide area of curriculum and syllabus of instruction which are acceptable to the great professional institutions from the Industrial standpoint and to the Board of Education from the Educational point of view ; and schools whose conditions were not altogether satisfactory have been induced to make improvements in respect of deficiencies where they had existed. The greatest advantage has been the creation of a system of examination which maintains the national standard while leaving great freedom to the school or institution as to the attaining of that standard. Great stress is also laid in this scheme on the performance of the student during his whole course extending over two or more years and the evidence he has given as to his diligence and ability during that course. It therefore has tended to eliminate the unhealthy habit of cramming and the factor of luck which so often creeps in an examination system in which a student's ability is judged by his performances within two or three days. In my opinion, the Scheme is worthy of thorough investigation with respect to its application to Indian conditions and I hope that the Association of Principals of Technical Institutions would be able to get the co-operation of the various Governments, Indian States and professional bodies. I will conclude my remarks on our needs with respect to technical education by expressing certain thoughts which have been in my mind for the last two or three years. With the advance in Technical Education that we are making now and which in the future years we wish to make, I feel that this is the time to urge on the Central Government that as far as Technical Education is concerned it serves not a provincial but a national requirement. With the provincial control of technical education certain unhealthy conditions creep in. Admissions, for example, are restricted, preference being given to the provincial domiciles; restriction in admissions ultimately leads necessarily to duplication of certain branches of technology and does create more technical institutions without adequate funds and with greater number of technical institutions it also tends to produce technically qualified men in excess of the demand. We cannot afford to have with our poor resources, courses in Marine Engineering, Aeronautics, Textile Engineering and Textile Industries and many other special branches of technology in every province. I would therefore advocate the organization of Technical Education on an all-India basis eliminating unhealthy competition but without doing away with healthy rivalry. This can only be done if Technical Education is recognized to fulfil a national need and the Central Government undertakes to play its national role in its conduct.

From my remarks which have been of more general interest, I would now turn my attention to post-war 'reconstruction' or 'planning' which will figure largely in the discussion of problems which the end of war will bring. Though the word 'planning' nowadays is used in a much broader sense than 'town planning', I am going to confine my remarks to 'town planning' only. In the past, the form and extension of towns was considered to be a purely local matter but now due to the modern traffic developments it has been realized that the restrictive outlook of the past was most unsatisfactory. There has therefore been a gradual trend in making town planning deal with larger areas which in some aspects may be nation-wide. This has resulted in some countries in great centralization of authority. It is likely that this trend may lead ultimately to some type of control which will be exercised over the whole country and will directly or indirectly determine the width and site of every new road to be made or old one to be reconstructed.

Countries where heavy damage has been caused by the war are seriously taking up the question of town planning of the future. For example, in Great Britain legislation in the form of Civil Defence Act has been enacted during the war period which throws the responsibility of rendering the whole or any part of the area to which the planning scheme applies less vulnerable to air raids. It is realized that radical changes will take place in the outlook of the people after the war in the nation-wide distribution of the population and in relative sizes and location of basic industries. A Council known as the '1940 Council' has been formed in England with the object of promoting 'planning'. This Council is representative of a number of Associations and Societies, such as the Town Planning Institute, the Garden Cities and Town Planning Association, the Council for the Preservation of Rural England, the National Housing and Town Planning Council, and others. The main objects of this body are the co-ordination of the work of all Societies and individuals interested in town and country planning, housing and the improvement of the living conditions of the poorer people of the country and preventing the overlapping of the efforts of societies and persons. This Council has also emphasized the need to plan from a national point of view in relation to the whole of the national resources.

Before the war, the Royal Commission appointed by the British Government on the 'distribution of the industrial population' had reached the unanimous conclusion that the circumstances of modern industrial and urban life were such as to require the setting up of a national body for broad purposes which might be comprehensively described as planning and were agreed to the broad principles of a national town and country planning policy. The Commissioners were also unanimous that the patchwork of local planning then in hand even if made to cover the whole country could never give birth to anything in the nature of a really national plan. It is considered now in that country that an opportunity undreamt of at the time when the Royal Commission was appointed, lies before Government and it should be used to the full by setting up a machinery for the development of a national scheme immediately.

The type of planning of future may be horizontal expansion, planned ribbon development, vertical expansion and the satellite town. The first two are unsuitable for mechanised transport while the third increases the traffic problem. The satellite town does not require the demolition of existing towns but it is simply a way of organizing future growth.

There is a tendency to think that the factor of bombing from air may be regarded as one which can be left to the antiaircraft services or as a housing rather than a town planning problem. Ultimately however everything will depend upon the international situation and the efforts made to remove the fear of war from our midst. Considerations, such as, how much regard should be paid to A.R.P., how many military aerodromes and how many training grounds and camps will be needed in peace time, will influence the planning of future. The fundamental principle governing A.R.P. in relation to civic planning is 'dispersion.' To attain this object, groupings of buildings will have to be relatively small and they may have to be made of the open pattern. The road system will have to be altered so as to keep through routes clear of building development and of adequate widths in centres of population. Dispersion of industries will also have to be carried out but a certain amount of groupings will be necessary in respect of communications, homes, power, services, raw materials, markets, etc. The areas occupied by industries will have to be well separated from residential areas by a belt of open space. The sites allotted for industrial and warehouse purposes will have to be very spacious so that buildings can be spaced wide apart. A spacious form of layout will minimise the risk of direct hits, will provide fire-breaks and will afford facilities for the digging of shelter trenches. Structural A.R.P. involves problems of camouflage and measures to resist structural damage. Camouflage has now become a great problem for the structural designers and planners. If however war considerations could be removed, progress in town planning would be greatly accelerated as many of the complications relating to the defence of the country would disappear.

It is most noteworthy that the British Government has lost no time in making a beginning in the direction of 'national planning' and has created a Ministry of Works and Buildings under Lord Reith. This Ministry is charged with the responsibility of consulting the departments and organizations concerned with a view to reporting to the Cabinet the appropriate methods and machinery for dealing with the issues involved in post-war reconstruction. The idea underlying the formation of this Ministry is to substitute order for chaos, to prevent vested interests and short-sightedness being perpetuated in new planning, to remove every obstruction which would come in the way of comprehensive re-planning. Lord Reith is being assisted by technical engineers and experts of wide experience. The Council of the National Building Industries has also been started to ensure effective liaison between the Industry and the Ministry. It has been realized that the Industry must forego its separatist outlook and co-operate whole-heartedly with Government. The ideals aimed at by Lord Reith's Ministry were indicated by him last year in a luncheon speech delivered before the Institution of Civil Engineers. He said :—

"Do not let anyone think that what he or anybody else might be doing about the machinery for planning, detracted from the war effort. The idea of a planned and ordered reconstruction was surely an incentive to encouragement of war effort. And surely engineers, of all people, so careful in planning their awn works, should welcome planning in this larger sphere. They should in fact be among those who, insisting on a proper design of whatever they were about to build, must welcome a design in Jiving not only in planned and ordered communities of concrete and bricks and timber and stone and steel, of highways and by-ways ; of farms where farms should be, and flowers and grass and trees where they should be ; of industrial communities where they should be (and definitely not where they should not be). There must be co ordination between living and working and moving and playing, with amenities natural and otherwise, of civilized life, instead of the haphazard confused disorder and inconvenience of our lives, the monstrous and obscene multilations of the countryside. "

'Lord Reith has also appointed a Committee to inquire into the question of public ownership, compensation and betterment and prevention of speculation in land. This Committee has presented an interim report to the Minister of Works and Buildings and it is understood that the principal recommendation made in this Report is that Local Authorities should be enabled at the close of the war to acquire land and sites compulsorily at the values reigning immediately before the outbreak of the hostilities. Special provision has been made in the War Damages Act, 1941, for the appointment of a War Damages Commission. This Commission is charged with the duty of executing the provisions of the Act in relation to the making of payments in respect of war damage to land and usual exercise of certain other functions. The Treasury usually make regulations in relation to the -exercise of the Commission's powers. This Commission is one of the most important that England has ever set up. By Section 7 of the Act, provision for securing public interest in the making of payments subject to Treasury direction is stipulated. It provides that where payments in respect of war damage are made, restoration or replacements shall be executed in conformity with the public interests as respecting town and country planning, the provision of housing accommodation, development of industry, services, agriculture, preservation of amenities, consumption of supplies of building materials and other matters. This important section has for its objective securing of public interest as a dominant consideration in making payments. If these wide powers are fully realized, the Commissioner will be able to exercise control of re-development in respect of blitzed areas and control over obstructive property that has suffered substantial war damage. These powers will be exercised in consultation with the Minister of Works and Buildings and allied Departments'.

The information given indicates what the British Government is doing to secure better planning during the war and post-war periods. In India, town planning, is still in its infancy and it has not yet extended to the non-urban areas but is restricted to a few Presidency towns. The existing legislation of the various Provincial Governments relating to town planning falls short of the present-day requirements and is in need of considerable improvements to accelerate the progress in this respect. It may however be found necessary in India in the post-war period to regard town planning a nation-wide subject and it is hoped that when such a necessity arises, we, engineers in India, will rise to the occasion and shall endeavour to develop planning schemes not only in respect of civic planning but also in respect of other activities on which the prosperity and well-being of the country depends.

These are a few of the problems which require our serious attention and I hope that you will interest yourselves in the suggestions I have made. It takes a bold person and a great deal of courage to foretell what changes will occur in engineering after the war has been won, but there is no doubt whatever that we engineers will have, as before, an immense influence in post-war. reconstruction. It is true that to-day the technical mind has turned its ability from creation to destruction, but this diversion is only temporary and it will not destroy the creative genius of the engineer for creating useful things for mankind with a view to give added comforts, convenience and luxury to modern day living. His enthusiasm and devotion to public service will survive and he will again play his proper part in the world progress.

Mr N V Modak—a Brief Profile

The Council have elected Mr. N. V. Modak as President of the Institution of Engineers (India) for the year 1941. Receiving his early training in the Government High School, and Fergusson College, Mr. Modak joined the College of Engineering, Poona and received his B.E. (Civil) of the Bombay University in 1911. He then served the Bombay Government until 1918, when he was offer ed a State Technical Scholarship for special work in Municipal and Sanitary Engineering. Mr. Modak proceeded to England and for major portion of his work was associated with the Corporation of Hastings. On his return to India he was appointed as an Executive Engineer in the Indian Service of Railway Engineers and posted to G.I.P. Railway as Sanitary Engineer. Subsequently his services were requisitioned by the B.B. & C.I. Railway as a Consulting Engineer to prepare a Sewerage Scheme for their Dohad Station. Since 1930 he has been with the Bombay Municipality first as Deputy City Engineer and then Hydraulic Engineer and in 1934 he was promoted to the responsible position of City Engineer to the Bombay Municipal Corporation. His activities in the promotion of engineering profession have been very wide and extensive. He has been past Chairman of the Bombay Centre of the Institution of Engineers (India), past President of the Bombay Engineering Congress and a Government delegate to the Indian Roads Congress. He is a Fellow of the Bombay University, a member of its Syndicate and Dean of the Faculty of Engineering. He is also a member of the Advisory Committee of the Poona Engineering College and of the Governing Board of the Victoria Jubilee Technical Institute, Bombay, a member of the Institution of Civil Engineers and the Institution of Municipal and County Engineers, London, and a Fellow of the Royal Sanitary Institute of London.

Sir Lakshmi Pati Misra

Esq., B.Sc. (Alld.), C.E. (Roorkee)

General Manager. B. & A. Railway.

President 1942-43

Presidential Address

Gentlemen,

I feel deeply grateful to you for this honour — the greatest in the hands of, the Engineers in India to confer on a fellow worker. Little did I expect when I entered the portals of the Thomason Engineering College — my *alma mater* — at Roorkee in October, 1907, about $35^1/_2$ years back, that I shall be called upon in course of my work, to fill this chair and shoulder its responsibilities, for great as the honour is, the responsibilities of this office, even in normal conditions, are greater still, and have increased much more in this period of stress caused by the greatest conflagration in human history — the present world war. Perhaps you remember that the last war was called by a great statesman as an engineer's war. If this remark was true then, it applies with greater force to the present conflict. The aeroplanes, the tanks, the wireless, the submarines, the anti-aircraft devices and above all, the general mechanization of the fighting forces, are the product of the engineer's brain. All these have been I much more highly developed, and are now being put to much greater use and test than in the last war.

2. Cynics might say that it is an achievement of which engineers need hardly be proud and that the occasion should be one for depression-if not shame-at the destruction caused by their inventions. Gentlemen, I feel certain that to such a baseless charge, the engineer must emphatically say ''No". It is his function to design and construct; the use to be made of his inventions is essentially outside his domain. After all, knowledge is Nature's armoury. The engineer picks out of it instruments which can be used both for destruction and progress, to alleviate and also to increase human sufferings. The use being made of the engineers'

achievements in this war is more a reflection on the ideals and not on the scientific developments of the age. The moral growth of man has failed to keep pace with the growth of science, with the result that there is maladjustment, and what was intended to make the world a better place to live in, is being harnessed to produce just the opposite effect. We should, however, have the satisfaction that engineers, on our side, are contributing most to stem the tide which, at one time, threatened to engulf—I should say, very nearly engulfed—all that man had valued and held dear in life. If, in the struggle ahead, the task before the engineers in the allied countries is severe, I can assure you, it will be severer for the engineers in India, because of its backwardness in industrial developments.

3. India is making a colossal effort to provide the sinews of war — machinery, munitions, equipment, roads, bridges, etc.—on a scale it never produced before. The engineer in India has not the resources of great industries to help him with tools and plant and material of the right type, available to his confreres in more advanced countries. War requirements are, on the other hand, of too pressing an urgency to await the arrival of material and plant of the right specification. From the point of view of the 'Forces', so long as the article or the structure, even if improvised, serves the purpose it is made for, the user is satisfied and the engineer has achieved his object, for it is the product that matters and not so much the technique employed in production. Improvisation should, therefore, be the motto of engineers engaged directly or indirectly in the gigantic effort which the country is making to help the Army in India in fighting and the industry in the supply of munitions and equipment. The engineer must improvise at each stage of production; the greater the improvisation, the greater will be the success of his war effort. Associated with a Railway in the war zone, I can tell you from my experience how improvisation has paid and will continue to pay if practised with discrimination. I have to emphasize this aspect of the engineering technique in war-time, for we must remember that in the present age no institution can hope to flourish, or even survive, unless it is based on service to society. It is by the service rendered that we shall be judged. We must, therefore, take stock in the work before us of the material and resources available, and continue to improvise to the best of our-abilities, so as to increase the general War effort to the maximum. In fact, even after victory has come-and you many rest assured that it shall in the fullness of time-improvisation shall always remain one of the most essential factors contributing to an engineer's success. There is, therefore, nothing lost and much gained by making a habit of it now.

4. Gentlemen, concentrate as we all must with all our resources and energies on the immediate war problems before us, it hardly behoves an Institution like ours, which exists to foster a healthy advancement of engineering in the country, to remain indifferent to any adverse forces crippling the service to society expected of the engineer. Basic essentials for the well-being and well-doing of the engineering profession in the country must continue to receive the closest attention of this Institution. This is all the more necessary, because peace problems for the engineer are going to be no less complex or difficult than what he has to face in the war. The time and consideration given to the improvements in the training and general equipment of the engineer will never be inopportune, nor even Interfere to any appreciable extent with the war effort. Those who have taken an interest in the problem are definitely of the opinion that the engineering training given in the country, which is· after all the basis of an engineer's equipment for his struggle in life, requires a thorough overhaul without which engineering in India will never attain that healthy growth so essential for its service to society.

5. The majority of the past Presidents of this Institution have touched on this question in one form or other in their addresses, and have stressed the need for doing something soon to improve matters, but very little has been accomplished so far. It behoves us even in the war-time to remove, or at least relax, where possible, the shackles which are cramping the profession. An engineer has been defined to be a man who can do for one rupee what a fool can do for two. The basis of this definition is not far to seek. An engineer gets accustomed both by training and practice to design and plan ahead, and thus increase efficiency and reduce waste to the

minimum in all he does. It seems to me an irony of fate that the planning and designing, which become by habit a second nature to an engineer, are conspicuous by their absence in the education and training given to engineers in India. No one can look at the institutions providing engineering or allied education in the country, without being struck by the lack of co-ordination between the industry or the profession to be served and the institution training students for this service.

6. The old established institutions imparting education in engineering and allied subjects were set up and financed by the Government, primarily to supply well-trained members for its technical services. The original expectations have been fully realized. These institutions have provided the public services with a band of trained engineers of whose achievements and devotion to duty any country may be legitimately proud. It cannot, however, be denied that the curricula prescribed, the training given and the general atmosphere in these institutions, though excellent from the point of view of the requirements of Government Service, are naturally different to what might be expected of technical institutions whose very existence depended on their satisfactorily meeting the growing needs of the profession or the industry they were supposed to be training their students for. Very little has been done in these colleges to foster the growth of, or establish intimate contact with, the branch of the industry or the profession concerned. The result is that throughout their long existence very few new ideas or even leads in the technical practices have emerged from the premier technical institutions in the country. I readily acknowledge that this is by no means the fault of the professors or teachers in the institutions and that the best amongst us, if we found ourselves in those institutions, would have done no better. It is also a fact that many among the professors could have done much better than what professors of similar technical institutions have done in other countries, if they had been given the lead. It is not even the fault of the Government, who found the money and engaged expensive professors. What has been lacking is the ideal and consequently the drive to make the training more practical and in keeping with the changing needs of the profession or the industry served.

7. In addition to the long-established institutions mentioned above, a number or other technical institutions have come into existence partly financed by Government. Many of these too have imparted education in an atmosphere of their own and have either done very little or have not been in a position to interest or associate the industry or the profession in the technique of the training of the students to be absorbed. The result has been a growing lack of co-ordination between the requirements of the profession or industry and the training imparted; so much so that many of the industries or firms, which could afford to do so, have started their own schools or made their own arrangements for training boys for their service, frequently at considerable expenditure to themselves and by duplicating some of the facilities of training already available in Government schools. The industries or employers are, after all, not to blame for they expect the recruit to render the service required, and if the training imparted is not, and cannot be, improved up to their requirements, they must in sheer self-defence meet their needs either by engaging persons with foreign training, or by training men locally at their own expense. The vicious circle in which the profession or the industry to be served will not, or is at least not enthusiastic to, absorb the technically trained men on the score of unsuitable training, and the technical institutions complain that the boys trained by them are not being given the chance they expect and deserve, must be broken at all costs, as it leads to waste of public funds over technical education, waste of effort of the students and a growing ill-will through unemployment between the employers and the technically trained students.

8. A solution must be found. Unfortunately the evil is too deep-rooted to be easily eradicated. The whole system requires a thorough overhaul. Any practical scheme devised must take into account and fit in the following 'obligatory points'—

(a) Provincial Autonomy under which education has become a Provincial responsibility.

(b) Increase in the number of engineering subjects in which training has to be given to meet the needs of newly established branches of engineering in the country.

(c) Inadequacy of funds available in the country for technical education, and consequent necessity to tap new sources for financing this education.

(d) To get the best out of what funds are available or which can be made available for technical education.

(e) The natural desire of the employers to employ recruits possessing the right technical knowledge, both theoretical and practical.

9. Provincial Autonomy.— In regard to Provincial Autonomy, the position is that, except for a few institutions fully or partly financed by the Central Government, education has become a provincial responsibility and if the present trend is any guide, each province is expected to look after itself and aspires to be as far as possible self-contained in educational matters, i.e., to have, if it desires, its own University and technical institutions and to restrict students from other provinces unless their governments are prepared to make direct and sometimes excessive, financial contributions. The provinces vary greatly in size and in resources. Some of the smaller ones have much smaller incomes than the gross earnings of an important Railway Station like Howrah, and can hardly be expected to become self-contained in regard to technical schools. Even in the case of big provinces, the demand for primary, secondary and general education in their areas is such that it is doubtful if they will be able to provide, within a reasonable time, the huge finances now required for developing technical education in all the branches of engineering now established in the country, and even if they did succeed, provincial patriotism, as it comes more and more into play, will place the smaller provinces at a serious disadvantage, and will inevitably deprive students from these provinces of the benefits of the technical education available in larger provinces. Such an arrangement will also result in duplication, in adjoining provinces, of the same facilities at generally below the proper standard, and inevitable increase in unemployment. In such circumstances, the chances of technical education developing on right lines in autonomous provinces, big or small, will be seriously compromised.

10. Some sort of central organization is, therefore, essential for co-ordinating the efforts of all the agencies now financing technical education in India-the Central and Provincial Governments, private enterprise or industrialists. One of my predecessors in this Chair advocated the establishment of a Central Technical University controlled and financed by the Government of India. Taking into consideration the fact that the Central Government is already either partially or wholly financing a number of technical institutions in the provinces, the suggestion, 'on the face of it, would appear to be a step in the right direction. In practice, however, it is likely to lead to serious difficulties. The size of the country will render centralized control ineffective and, to a large extent, inefficient. The Central University will have to be an examining University for the whole of India, and as technical education develops in different branches, one University financed by the Central Government may soon become too unwieldy for all the provinces and for all branches of engineering. It will also tend to create among provincial governments the feeling that the establishment of technical institutions, benefiting professions or industries in the provinces was no longer their concern. A Central Technical University should, therefore, be ruled out of consideration. It would probably be more practical if, instead of taking over the whole responsibility for financing, administering and examining technical institutions all over the country, the proposed central authority confine its attention only to the following—

(a) To utilize to the best advantage the funds already spent on technical education all over British India, i.e., to avoid unnecessary duplication of facilities for training students for the same branch of engineering or industry in adjoining provinces mainly on grounds of provincial pride or patriotism.

(b) To determine, in consultation with local government and industries, what new technical institutions should be established and where, and what subjects are to be taught in them.

(c) To start new and improve, the existing institutions; and to arrange for additional funds partly from the industry or trade in whose interests the new technical institution is being brought into existence and partly from the Central and local governments according to circumstances.

(d) To locate new technical institutions intended to serve a particular industry in the area where the industry has developed, so as to ensure for the students a practical and intimate association with their future sphere of work from the very beginning of their training.

(e) To give the industry some voice in determining the number of students to be trained and the courses of studies in these institutions, so that the training imparted meets the requirements of the industry, and unemployment is reduced to the minimum possible in the circumstances.

(f) To encourage the industry to hand over its research to the institutions established for it.

(g) To organize courses in the technical institutions both for the Managerial and Foremen classes and, where possible, for the workmen also by holding classes in shifts in the same building.

(h) To make technical education cheap and, as far as possible, self-supporting for the students.

(i) To utilize the building and equipment, provided for technical institutions, for other educational activities where possible, e.g. for night classes for workmen and others who care to take advantage of them.

11. Funds. — In regard to funds, resources of both Central and local governments are limited. Whatever is available is hardly likely to be sufficient in the near future to provide for training in all technical subjects for which demand has arisen on account of the growth of new industries or special branches of engineering. To meet this growing demand, it is only fair to get the industries to share the financing of the technical training of their future employees in the form of a small cess on their out-turn. They should, in return, be given a definite voice in determining the courses of studies and training provided for the students they may be expected to absorb. Such an arrangement will automatically ensure to students a course of practical and theoretical training suited to the requirements of the industry they are being trained for and also employment on completion of their training. In those branches of engineering or industrial enterprises in which the Government is the sole employer, the technical department of the Government will take the place of the industry, and shoulder its responsibilities and powers.

]2. Duplication. — We have at present a number of technical institutions teaching the same subject and turning out students without any regard to demand. There should be a survey of the requirements of each branch of engineering or industry, and the number of students to be admitted to the institutions catering for it should bear some proportion to the actual requirements of the industry. Overproduction should be reduced as far as possible.

13. Expensive Technical Education. — At present, technical education is very expensive. In the long-established institutions referred to in paragraph 6, it is almost prohibitive and quite out of proportion to the general standard of living in the country. As long as recruits from these colleges were given high salaries in Government service, there might have been some justification for raising their standard of living, but now that the students have mostly to look up either to private enterprise or service in a private firm, the cost of education should be considerably reduced. There is a certain amount of incongruity in accustoming a student to spend Rs. 100/- to Rs. 110/- per mensem during his education and throwing him on the world after his training to secure a job of Rs. 80/- or Rs. 90/- per mensem. Cheapening of the education will not only draw students from classes, which have special aptitude for engineering, but will also enable the students to meet some portion of their expenses by taking up work in vacations.

14. Classes to be held in shifts.-Industries and workshops frequently work in shifts to get the best out of their buildings, equipment, machinery, etc. provided. In the case of technical institutions, costly buildings are erected, and if they happen to be utilized for four or five hours out of twenty-four, it is considered a good achievement. The country is too poor and the resources of the Government and public too limited to tolerate such a waste. There is no reason

why classes should not be held in shifts. My immediate predecessor in the chair, in his brilliant address, stressed the necessity of technical institutions training up Managerial and Foremen classes. If the training imparted is given in shifts, it will be possible to utilize the same building for both classes of students and at a much less additional expenditure than would be required if. separate buildings were provided for each class. In fact if classes are held in shifts, it may be possible for some students of secondary schools simultaneously to take up some of the elementary technical classes side by side with their secondary education, it will be a saving in time for them, as technical education has to be imparted in India in a foreign language and our boys have first to acquire a certain standard of proficiency in that language. Technical education has therefore to start in India two or three years later than in other countries. If a technical institution starts night classes, it will be possible for some of the students, undertaking secondary education, to take advantage of the night or evening classes and save the time spent in learning the elements of technical education in the first year of the course.

16. In regard to labourers, the present position in the majority of cases is once a labourer, always a labourer. This could hardly be called a satisfactory arrangement or in the best interest of the industry. In course of my experience I have met intelligent labourers who could, with a little training and opportunity, have acquitted themselves creditably in very much higher posts, but had to be kept out of them for want of education and remained where they started. I was much struck in course of my travels in Germany by the law under which all employers, employing more than a certain number of men, had to provide night schools for them, and to encourage attendance in night classes by payment of special bonuses for passing certain examinations or acquiring a particular standard of efficiency. Some general education or vocational training should be provided for labourers in each industry in order to give those, aspiring to rise high, a chance to do so. Such an arrangement would give opportunities to the more ambitious and intelligent among our workmen and will, to a very great extent, take the sting out of the present discontent and agitation against the employers. After all it is not every labourer who wants to get to the top or feels a grievance because he has not done so, and if those who aspire and are deserving are given a chance to rise to higher posts, much of the present discontent will automatically disappear.

16. In short, the scheme placed before you envisages a Central Regulating Authority for—

(a) rationalizing technical education all over British India by co-ordinating the facilities for such education already provided by the Central and Provincial Governments and industries established in the country;

(b) re-organizing the courses of studies in the existing institutions with a view to obtaining the maximum out of the funds and equipment provided;

(c) arranging funds for and establishing new institutions solely from the point of view of the requirements of the industries to be served and independently of provincial patriotism or prejudice;

(d) enlisting active association of the industries with the existing or new institutions built for serving them, and securing therein a type of training suited to actual requirements;

(e) regulating the number of admissions to institutions under its control in accordance with the demand, existing or expected, and thus avoiding overproduction and unemployment;

(f) leaving the question of examinations and day-to-day administration of the technical institutions to the provinces and the industries concerned.

17. How the Central Regulating Authority is to exercise the functions mentioned above, what machinery is to be set up and what statutory powers are to be given to it to enable it to function satisfactorily are all points of detail which will have to be closely studied by the Central Government in consultation with the provinces and the various industries for whose growth the development of suitable technical education has become a vital necessity. These are obviously matters on which there is bound to be an acute difference of opinion between the

Central and local governments and the industry. I hope I am voicing your feelings if I say that if the Central or local governments want any information from or wish to take advantage of the experience of this Institution, it shall be readily given. What is required is a preliminary survey to collect the data in regard to the funds spent, the number of students trained and annually absorbed, the accommodation and equipment available in the technical schools in the country, how far they can be expanded to embrace other activities, and the requirements of the new industries to be served. Once this information has been collected, it will be time for the Central Government to consider the statutory powers to be given to the proposed Central Regulating Authority.

18. After consulting a number of persons, whose opinion should count in such matters, the following rough scheme is being put forward merely to give you a general idea of the machinery which will have to be set up for fostering the growth of technical education on the lines indicated in the previous paragraphs.

(a) Each industry, whose development has reached a stage at which its growth depends on the provision of adequate technical education in the country, should have an officer of the Central Government, an Inspector or a Superintendent or a Controller, for looking after the technical college or colleges established or to be established to serve this particular industry. He should be assisted by a Board of Control, consisting of two representatives of the industry and two nominees of the local government, preferably of their Industrial and Educational Departments.

(b) The authority at the centre should be vested in a Chief Controller or Inspector assisted by a similar Board consisting of representatives of the provinces and the branches of the engineering to be catered for.

(c) The Central Authority should be responsible for examining the proposals for new institutions, finding funds for those approved and generally laying down the broad lines of policy for the guidance of the provincial colleges working under its guidance.

(d) The funds available for technical education in the Provincial and Central budgets, or spent by industries should all be taken over by the Central Authority and pooled. They will be increased by a special cess on the out-turn of the industry or industries to be served.

In short, the function of the Central Board will be—

(i) to determine what subjects will be taught in the existing institutions:

(ii) to determine what new technical institutions are to be started and where they are to be located;

(iii) to allot funds for those to be started and for improving those in existence:

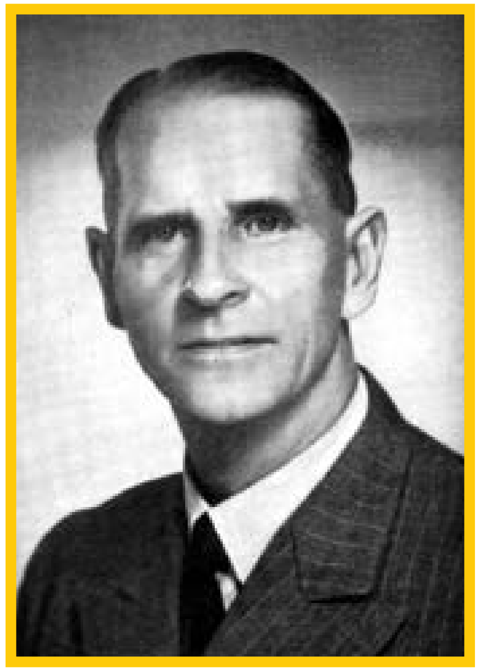
The Provincial Boards will control, under the guidance of their respective Inspectors,

(i) the curricula: and the day-to-day administration of the technical institutions set up;

(ii) the question of affiliation with local Universities; and

(iii) the practical training of the students in the industries to be served, which must be made obligatory under the law.

19. Gentlemen, the above is only a skeleton scheme put up for your consideration. Like most of my predecessors in this chair I do feel strongly that something must be done. Unless something is done soon to rationalize engineering or technical education and training, the industries now developing all round will fail to keep their head above water in the deluge of competition which must inevitably follow the cessation of hostilities. The country is not rich, nor developed enough to permit waste of either funds or effort. Its needs are growing and must be catered for. Efficiency must, therefore, be our watchword, whether in the actual practice of the profession or in the early training of the engineer. In fact without efficiency in training, it would become difficult to ensure it in practice afterwards.



Mr T R Sneyd-Kynnersley

Esq., C.B.E., M.C., A.C.G.I., M.Inst. C.E., M.I.Struct.E., M.I.E. (India)

Chief Engineer, The Concrete Association of India

President 1944

Presidential Address

Gentlemen, In the first place I should like to express my gratitude to the Council of this Institution for electing me as President for the ensuing year and thank you all most sincerely for the great compliment which this implies. I can assure you that I shall try to carry out the duties of this high office to the best of my ability and I feel certain that I shall have the assistance and collaboration of the whole Institution. in my task. We are passing through days of great strain to everyone, but it seems quite certain that we have passed the turning point in this world-shaking war and that the sands are rapidly running out for the enemies of civilization. We should not, however, be content to wait quietly while the Armies, Navies and Air Forces of the Allies are doing their job. We must set our minds and energies to the task which confronts us at the moment. We must first put our own house I in order in readiness for the task which lies ahead, and we must give all possible assistance in planning for the development of India, for just as this Wer is an Engineers' War, so should the ensuing peace be an Engineers' peace. Much has been said about Post-War Reconstruction, and the Government of India and the Provincial Governments are already tackling the work of planning, but no reconstruction can take place without Engineers, and if we have a hand, as we must, in this momentous work we must also realize that it carries with it great responsibilities.

H.E. The Viceroy's Statement

In opening the Indian Science Congress recently, H.E. the Viceroy made the following statement:-

"If India is to play the part in the world to which her size, her population, her history and her position entitle her, she too must make every possible use of scientific advancement.

Her contributions to science have always been on the side of peace and progress. She has everything to gain by combining modern science with her old culture. Her traditional outlook should enable her to make an increasingly fine and characteristic contribution to natural knowledge."

President Roosevelt

I would also like to quote the great President of the United States of America, Mr. Roosevelt, who recently issued a New Year message to the people of the United Nations to pledge their determination to continue war -time co-operation in the days of peace :-

"We are on the offensive. The walls are closing in remorselessly on our enemies. Our armed forces are gathering for new and greater assaults which will bring about the downfall of the Axis aggressors. The United Nations are giving attention also to a different kind of struggle which must follow the military phases-the struggle against disease, malnutrition, unemployment and many other forms of economic and social distress. As we look towards the tremendous tasks ahead let us pledge ourselves that this co-operation shall continue both for winning the final victory on the battlefield and for establishing an international organization of all peace-loving nations to maintain peace and security in the generations to come."

In these great words expressing hope for a better future we can surely find inspiration.

I now propose to touch briefly on a few matters most concerning ourselves.

Administration

In the 24 years of its existence this Institution has undoubtedly done useful work; it has created a name for itself and is being recognized more and more by Government and the Public.

It has now 8 centres and its membership, which stands at about 1,900 to-day, is increasing, though slowly. Associations of Engineers outside its fold are being gradually merged into it, e.g., the Bombay Engineering Congress-with its distinguished record of 29 years of useful service. This, I feel sure you will agree, is a healthy sign.

There are still many Provinces which are without centres of their own.

We must move with the rapidly changing conditions of to-day. At present too much of our time would seem to be taken up with routine administration and not enough with constructive effort; to use an old expression, we run the risk of not seeing the wood for the trees.

Centres can take the initiative in many ways, such as:-

(l) Procuring their own buildings.

(2) Making a census of Engineering establishments and finding out qualified Engineers who are eliqible for corporate membership and who are not yet in our Institution.

(3) Holding paper meetings in up-country stations in addition to those at headquarters.

(4) Appointing sub-committees and seeing that they work .

(5) Collecting valuable articles for our Journal.

I look forward to the day when all important matters relating to Engineering in this country are naturally and automatically referred to this Body-with Public Service and other Commissions taking the Institution more into their confidence. In this connection I would again put forward the suggestion made in the past by former Presidents that all Centres make a point of seeing that no engineer of proved merit and experience be allowed to stay outside the Institution's fold. It is quality we ought to seek after rather than quantity, and we must ask ourselves why there are senior and well-known engineers occupying high positions who do not yet consider it incumbent upon themselves to join the ranks of the one Engineering Institution in India which holds the Royal Charter granted by the King Emperor himself.

Economy necessary

There is an increasing need for economy in the spending of our funds. If we are to have a strong centre and a first class Technical Secretary, Provincial Centres must spend less or contribute a part of their own finances.

Membership in a technical society offers an engineer a good opportunity to keep in touch with the investigations and opinions of leaders in his chosen fields of specialization, thereby supplementing his own knowledge by the experience of others. Such membership also provides an opportunity to gain knowledge of developments in closely related fields of engineering.

Membership alone however will not get an engineer anywhere; he must be a worker as well. In his younger days, his work will be chiefly that of a student, but as he grows older he will be able to contribute his research or experience. Unless those who are marking up progress in engineering do participate in this way I technical societies can be of little service to the profession. Only by each individual doing his part can there be advancement adequate to keep pace with the developments that are rapidly changing the engineering horizon. It is essential that engineers pledge their wholehearted support to their profession and take a more active part in its technical Societies.

Registration of Engineers

The next point that I want to touch on is the registration of engineers. It seems to me most important that engineers should protect their interests in every way possible. Doctors, Accountants, Lawyers and Architects seem to have succeeded in looking after their own interests very much better than Engineers and I think it is high time that we did something about it both for our own advantage and that of the public. After the war new industries will be started and thousands of new buildings will be constructed; in many cases these will be of a complicated nature demanding the closest possible association of Architects, Engineers and Builders. I have seen it suggested in the English papers that every firm connected with building should have partners connected with both the Architectural and Engineering professions and that all new entrants should be required to pass a statutory examination ensuring that they possess sufficient basic knowledge of their trade to enable the community to feel safe in giving them a reasonably free hand in complying with the structural demands of the building laws. In this country there would probably have to be two grades of statutory examination but this should not be an insuperable difficulty.

Revised Building Bye-laws

The recent disaster to a five-stories building in Bombay serves to remind us of the necessity of taking every possible precaution to see that such a thing will not happen again. There seems to be a very definite need for revised building bye-laws throughout the country, but these must take into consideration the enormous advance in the manufacture of structural building materials and methods which have developed recently. If on the one hand no building could be put up without the signature of a Chartered Engineer and if a code of payment for work done could be agreed upon, we should be taking a great step forward. Other professions have managed to look after themselves in this manner and I fail to see why we should not do the same, and this Body should see that such a reform is carried through.

Many of us feel that the word 'Engineer' is too vague, covering as it does such a vast field of human endeavour and describing grades of people as far apart as the humble mechanic and the Chief Engineer of a great railway or irrigation project.

Chartered Engineers

We have the term 'Chartered Engineer' but how many of us use it! It does not slide off the tongue in the same way as Chartered Accountant. Why not! Why should not this parent body encourage everyone of its members to style himself as a Chartered Engineer on every possible occasion so that in due course the expression will be synonymous with a man who is properly qualified in the' particular branch of the profession to which he belongs, whether he be a Civil, Mechanical, Electrical or Chemical Engineer. We must never lose sight of the fact that our Institution must look after the needs of all.

I now propose to touch upon certain points brought out by previous Presidents in the last few years, as continuity is of great importance.

Public Affairs

One feature that appears to be pre-eminent is the necessity for engineers to take more active interest in public affairs generally; that is, engineers who have the time, either by virtue of having retired from their profession or otherwise, should do all they can by articles, letters to the press, etc., to educate the public in the economic value of sound engineering. Erroneous statements regarding engineers should be challenged and the welfare of the profession as a whole fostered. The interdependence of the Engineer, the Architect, the Physicist, and the Chemist should be stressed. Syllabi as applied to engineers in schools and colleges should be watched constantly and kept up-to-date. Education of engineers should be put on a proper basis and should include the elements of Civics and Psychology. For this purpose a permanent Educational Committee, who really have time to work and pull their weight, should be a living feature of this Institution.

Selection of young men

Mr. Modak jn his address in 1941 referred to catching the young men of the country in the kindergarten stage. There is no doubt that many boys are pushed into engineering by their parents without due regard for the natural aptitude of the boy himself. Boys should be selected for an engineering career just as they are for the Navy, and only when they appear to have a natural bent for the profession should they be encouraged to proceed.

Consideration should be given to the "Sandwich System" (as compared with the "Co-operative System") which is being developed in the United States of America, courses being arranged in such a way that the practical problems arising in the workshop are dealt with from the theoretical standpoint in the classroom immediately in the succeeding week. That is to s-ay, theoretical instruction is planned with a view to helping a student to accomplish his practical task more quickly and efficiently and at the same time with a more perfect understanding.

Raja Jwala Prasad, in his Presidential Address before this Institution in 1932, suggested the formation of an All-India Engineering and Industrial University wherein all the Engineering and Industrial courses should co-operate in training the youth for the material and economic uplift of our country. He further said "We may be good irrigation, building or railway engineers but we are yet far behind in other important branches such as marine, agricultural, aerial, military, electrical and mechanical engineering." I fear these strictures are very nearly as true today as they were 12 years ago.

In selecting the aspirant to Engineering degrees you can either sum him up by three or four days' intensive examination by written papers or you can judge by the reports on his work taking into consideration the aggregate total of marks scored over 3 or 4 years. Surely the latter is a far better test of the man himself and how he can be expected to use his brain and the knowledge he has acquired. Many people can cram for an examination who turn out to be quite useless as practical men. I would support Mr. Modak's suggestion to press for more Research

Laboratories and the development of Polytechnic Institutions, which are essential, as they train the foreman type which is almost as important as the managerial or research type. After an initial grounding, each boy should strike out on the lines that suit him best, for, without personal interest in his work, no man can get to the top or succeed in life.

Lack of coordination

Our retiring President, Mr. Misra, brought out the defects in our educational system in his Presidential Address and was of the opinion that engineering training in this country requires a thorough overhaul; there appears to be lack of co-ordination between our profession, the industry and the young men who will be the Engineers of to-morrow.

The Industries that can afford it have been forced to provide their own schools and make their own arrangements for training boys for their service. This is surely far from satisfactory. Mr. Sargent's carefully devised scheme of education deserves all possible support, for without education there can be no progress.

I think that the Institution should take a more active interest in the development of technical education for Indian Industry on a National basis and should consider a National Certificate Scheme, specially in Mechanical and Electrical Engineering, Better arrangements for the training of students by the extension of pupilage and apprenticeship also need very early consideration, and in this connection we must work for the closest possible co-operation between Government, this Institution and the Engineering Industry.

The tasks before us

Let us now turn to the immediate present ami to some of the manifold tasks which lie before us.

Agriculture and Industry

In a short address of this kind, it is obviously impossible to do more than touch upon the multifarious activities of the engineer in the post-war period in a country which is said to contain one-fifth part of the human race.

Quoting from "The Wealth of India" by Professors Wadia and Joshi:-

"72 per cent of the population is dependent on agriculture; the co-ordination of occupations which once existed to a large extent, which distributes the population between those who produce the raw materials and food, those who transform these materials into manufactured commodities, and those who exchange and circulate them, has now given place to an economic organization in which the large majority are dependent on the single and somewhat precarious resource of agriculture. In this ruralisation is to be sought the ground of Indian poverty.

... ...As long ago as 1880 the Famine Commission clearly grasped the fundamental economic issues at stake when it pointed out that the only remedy for the recurring disasters of famine was the rapid industrialisation of the country, providing diversified employments to the people."

H. E. Sir John Colville, Governor of Bombay, while opening the Sixth Agricultural and Cattle Show at Nadiad on January the 12th, said:-

"lt is the welfare of the cultivators and the welfare of the people living on the land in India which counts for so much and unless their welfare is ensured and the standard of living improved, there can be no real progress in this country."

Food Supply and the Engineer

Can Engineers help to grow more food? Of course they can and they should. The agriculturist depends very largely on the engineer for making his machinery, pumps, ploughs, graders and so forth. He must be instructed in the working and proper maintenance of these machines. The engineer, by building more roads, must help the farmer get his produce to market. He must build' his silos, wells, cow houses and the many adjuncts to the farm which the average farmer in Europe and America considers indispensable. He must assist in schemes for stopping erosion and de-forestation which are ruining parts of the country.

In this connection I quote Dr. R. Maclagan Gorrie, who, in his paper read before the Crops and Soils Wing of the Imperial Council of Agricultural Research, made the following points:

Co-operation, said Dr. Gorrie, would be needed after the war between Army Units with very large forces of men trained to tractor driving. Their road graders and other earth-moving machinery could be used and lent to Provincial Governments for definite projects in districts which have appreciable numbers of demobilised men returning to them. Much of the realignment of sloping lands could be done by bull-dozers and road graders. The only other machinery required would be trailer ploughs capable of sub-soil ploughing. These could readily be made up in local workshops copying the type already in use in Patiala State but the tractor power could be provided by Bren Carriers if tractors were not available.

The manual labour required to accompany and supplement the tractor work could be provided by the demobilised men themselves working in district Pioner companies which would retain each man's services until his homestead was rendered fit for occupation, but which would constitute a permanent activity as an auxiliary unit. Proposals along these lines have already been submitted by Colonel Sir Dashwood Strettell as part of his Resettlement and Reconstruction programme, but with the main emphasis placed upon road making, with a policy of making village roads feeders to the railways rather than in competition with them.

When men from the Services are being re-absorbed into civil life, engineers must not be forgotten, as, from their training, they are eminently fitted to. deal with reconstruction in its many forms.

Irrigation

The total land under caltivation in India is about 270 million acres of which only 52 million acres —or approximately 20 per cent—are irrigated. Whereas Sind is lucky enough to have 73.7 per cent of its cultivated area irrigated, the Punjab has 44.1 per cent, Hyderabad 6.9 per cent, Bengal 6.2 per cent, C. P. and Berar 4.2 per cent and Bombay only 3.9 per cent. This matter was referred to in Mr. C. E. Preston's illuminating address to the Hyderabad Branch of this Institution on December the 11th , 1943, which is well worth studying.

There are approximately 50 lakhs more people added to the population of this country each year. Think what this means to an already poor country.

Birth control, advocated by many, is not I think an engineer's job but it is our job to concern ourselves with vital statistics and to help the powers that be to cope with what is undoubtedly happening in this country, namely, a rapid increase in population without an apparent corresponding increase in food and amenities of life.

The farmer in this country is desperately poor, he cannot afford the means to become efficient. Surely no greater work can lie before Government than active assistance in helping him tide over the period when he is being taught to become more efficient.

Soil, which is impoverished, must be recuperated by scientific methods.

Fragmented holdings must be worked as large units for which legislation will be necessary.

There are agricultural colleges and scientists who know what should be done, but it cannot be done without "pump priming".

If we spent one-tenth part of what we have to spend in war on the work of making India more prosperous, we should reap such harvests from every form of human progress that the present poverty-ridden, under-fed millions would provide ample repayment and instead of famine and distress we should have prosperity, contentment and work for all.

Crops cannot be grown without water and cannot be moved where they are wanted without suitable means, so the fundamental issues resolve themselves into more irrigation and more and better communications.

Most Provincial Governments are alive to the need for further irrigation schemes and there are many well-trained engineers who can very well cope with this work. There are also many trained railway engineers under properly organised control who have shown by their work in the last 4 years how capable they are. Navigable waterways and the movement of goods by river craft and by coastal streamers and sailing craft are fairly well advanced and in the hands of men who know their job. But when we come to roads, what a sorrowful picture this country presents!

Roads

How vital roads are in time of war, was illustrated by the grievous lack of them in the recent campaigns of Malaya, Burma and Libya, rendering it impossible to concentrate our limited weight of men and metal in the right place at the right moment.

China would not now be so isolated as she is if road and rail links between India and Burma had been forged as a precaution against an interruption of our sea communications.

It is easy to be wise after the event but surely the tragedies of 1941 should have taught us a lesson we must never forget.

At last, however, with the increasing interest recently shown by His Excellency the Viceroy, the Government of India and the Provincial Governments, it really looks as if the making of good roads is going to be put on a sound footing, and we as engineers must be ready for this development.

If road engineering in this country had been studied and planned in the same way as in America and many other countries of the West, we should have nothing to fear, but this is not so; and it is high time that young engineers were encouraged to specialise along modern scientific lines connected with construction and maintenance of all kinds of roads.

This is the psychological moment. Let us no longer think of road engineering in terms of the steam roller, the red flag and the maistry. Communications must be driven through to the uttermost ends of the country, to the most out-of-the way villages, for nothing short of penetration by roads to the recesses of this vast country can bring prosperity to the 750,000 villages which form the homes of the great majority of the people.

How can education and better health spread without communications? The education of the masses must be the goal sought after before we can even begin to think of the thousands of benefits which a civilised country should consider as the right of every man, woman and child. Let us learn to walk before we can run. There must be vast power-schemes with a net-work of high-tension wires bringing the benefits of cheap electricity to every village home. and cheap current to drive the water pumps which will bring life to the thirsty soil, so we must get on with roads without further loss of time. Travelling, Libraries, Cinemas, Radios and all modern amenities which practically every member of the American public enjoys may be brought to the millions of the people of this country only through better communications.

Educationists believe that the radio is one of the best and cheapest forms of bringing enlightenment and knowledge to the vast masses of India, but battery sets must be ruled out on the score of expense and the real development of radio education must depend 'on the advent of electric current to rural India.

Industrialization

Any scheme of public works in India must embrace the employment of large sums of capital in constructing roads and railways and in developing power. They are necessary to mitigate industrial fluctuations; but they also ensure a sound basis for industrialization, for industries will always follow transport facilities.

When these come and education spreads, industrialization of the country will be the natural corollary and with the development of the manifold riches and mineral wealth of the soil will come the dawn of a new era of happiness and prosperity, and perhaps with these things the end of political strife, poverty and discontent.

Buildings.

Now let us consider the structural side of our profession in so far as it impinges on housing.

After the war there will be a serious shortage of trained manpower and materials and we shall probably have to improvise from all available resources. As already mentioned, building bye-laws must be brought up-to-date and rule-ofthumb methods so prevalent in this country must be gradually discarded in favour of more scientific designing. Lightness ought to be the watch-word of the house designer; for years, we have been used to building structures which not only put unnecessary weight on foundations but also on the lower floors' which have to carry the weight of the rest of the building. Reinforced concrete frame houses are becoming popular, but owing to the scarcity of steel and cement during the war, there has been a great set-back in building and there will be enormous lee-way to make up. It is time that the authorities concerned got down to serious planning not only in general terms but in actual type specifications so that work can be put in hand, the moment materials are available.

Modern science should play a far greater part in the design of buildings. Future codes of practice must consider A.R.P. safety measures, fire resistance and hygiene, the introduction of new materials should be encouraged, designs should be standardized and simplified. The time taken for authorities to give approval to plans must be minimized.

New materials and Processes.

Old process should give way to new. Riveting must give way to welding. Heavy materials must give way to light ones. The science of plastic will enter into our post-war designs and glass, pressed fibre, insulating boards, hollow block construction, etc., must all play their part. Engineers, Architects, Plumbers and Artists must all work together. Beauty should not be sacrificed entirely to utility, and all should combine to bring about happier and healthier living conditions.

Woman Architects.

There ought to be more women Architects to help in designing our homes as they naturally have a more intimate knowledge of what is really wanted. Air conditioning will form an important feature in the houses of to-morrow, but designs must be completed at the start and not slung together in a haphazard manner with a thousand and one after-thoughts, as is so common at present.

Overcrowding

It is said that three-fourths of the population of the enormous city of Bombay live in single rooms with more than 4 people in each. This kind of overcrowding must bring disease and misery in its train.

The enormous improvement in aeroplanes induced by the war must make us realize that we are entering upon an aeroplane age when practically all first-class passenger traffic will go by air.

In Town Planning we shall have to think, not only of parking places for cars, but also landing places for helicopters, for the day is not far off when business men and others Will be able to live in pleasant surroundings far away from. their offices. They will fly every morning to landing grounds as near the city as possible, fold their wings and drive to their respective places of business. These are not dreams of a far distant future, they should be everyday occurrences within a few years of the end of the war.

Post-war planning

Finally we come to the all-pervading topic of post-war planning. Quoting from "Planned Economy for India" by Sir M. Visveswaraya:

"A body with a Plan, however much we may dislike it for particular reasons, is preferable to a group sauntering down the road complaining of the economic weather and wondering when the fain will stop."

"To solve our problems, the ideals of sacrifice, surrender and service should be accepted in the place of mere individual gain, personal profit and single objective."

Planning means Organization. In England they are talking of a Four Year Plan. Why should India riot have its Four Year Plan or even a I5-year plan? Objectives must be defined, in peace-time as in war. In war-time life is hard. We all have to work longer hours and in less confort, but things get done, and the common object is achieved, mainly through collective effort, determination and the fact of having a goal at which to aim.

In peace-time there is no common goal, and very little discipline. Most people think and work only for their families and themselves. There is a minimum of co-operation, with the ensuing confusion and disorder which we are so used to. If we have a long term Plan and if everyone works for it as we work in war, the Plan will stand some chance of achievement. If we go on working separately-each one for himself-with no common Plan, the results are bound to be unsatisfactory. .

Comparable with India is Russia, where her enormous size renders the question of communication one of the utmost importance.

Nearly 70,000 miles of inland waterways are classed as navigable; there are 50,000 miles of railway as compared with 41,000 in this country. Regular air routes cover something like 30,000 miles. She has worked on a series of 5-year plans of which the main objectives have been industrialization to make her a self-sufficient economic unit and the redistribution of her industry in such a way as to locate the great enterprises in places where power, (coal, oil, water or peat) are available. Where abundant supplies of raw material particularly heavy and bulky raw material-exist, she has utilized to the full her labour resources in different parts of the country .

Russia, after the last war, was an impoverished and stricken country. In 1928, they started the first of their Five Year Plans. By concentrating on these, they were able to create a new Civilization in which everyone participated. New industries and properly planned towns carne into existence. Agriculture was revolutionized by modern methods using large quantities of tractors and machines of every kind. The arts and sciences of civilization and organized development gradually took hold on a mighty people, so that when the testing time carne, and Russia had to fight the greatest army the world had ever seen, she was strong enough to do so.

India in many ways, with her vast population and only partially cultivated lands, can be compared with the Russia of 20 years ago. Organized planning appears to be our only hope, and this is the psychological opportunity which, if not grasped now, may be lost for years to come. . In this connection we are reminded of "A Plan of Economic Development for India" produced recently by eight leading industrialists and economists of India. It aims at a l5-year plan of development at a cost of Rs. 10,000 crores, of which industry, communications and housing will absorb about three-fourths. Here is an enormous field for engineers in which the Institution can playa useful part

Tennessee Valley Authority (TVA)

There will be so much planning on a large scale after the war that this country cannot afford to neglect the experience gained in 10 years' work on the world's boldest venture in regional reconstruction. I refer to the Tennessee Valley Authority. The scheme covers an area nearly the size of the Punjab. The Tennessee Valley used to be known as one of the most depressed areas of the United States. Its disastrous condition was due to reckless exploitation by early settlers. The soil was barren, the woods had been cut down. The rivers constantly broke out in enormous floods. So TVA began its work of water control. Huge dams were built, lakes created and vast hydro-electric plants established, while concurrently a network of research was flung across the whole area. State universities and colleges helped to survey it and to recover prosperity. Soil regeneration, afforestation, malaria control and the like were tackled scientifically. National parks were created, tourism developed, cultural and educational activities started and promoted. All this TVA regards as part of the regional planning authority's job. Too many people still think of planning in terms of advisory town-planning committees without the executive power necessary for drawing up schemes for urban and district councils. There is no object lesson anywhere so convincing of the possibilities judiciously and democratically applied to regional planning as TVA.

It must not be thought that the TVA scheme went through without hostility. Hostility to large-scale Government planning is bound to occur in democracies and sometimes clothes itself in political forms. It is said to interfere with the sacred constitutional rights of the people of the country to engage in trade or business for themselves. TVA incurred the wrath of the professional politicians by steadfastly refusing to have anything to do with the traditional system of political patronage; all appointments under the Authority are made on merit. Tens of thousands of letters and telegrams were received demanding that TVA jobs should be distributed according to the bad old system. However, the President refused to budge and this particular storm soon died down, all the sooner because the inhabitants of the Valley were not long in discovering that the absence of patronage, graft, and the spoils system made for more efficient and more understanding administration.

Other opposition came from the coal-owners, who disliked the competition of cheap power, but finally all these snags were got over and TVA remains as one of the finest co-ordinated efforts for the benefit of the multitude that the world has ever seen, and I earnestly commend a careful of their methods to all planning authorities in this consideration country.

In this connection let us look for a moment at how a great sister organization is coping with post-war problems.

American Society of Civil Engineers

The American Society of Civil Engineers, over ninety years old, is composed of nineteen thousand members united in support of the highest professional ethics and sound engineering practices. They serve in industry, in consulting practice, and in engineering departments of Federal, State, and Local governments, with widespread geographical distribution. The Society offers to the government and the people of the United States its facilities and the accumulated knowledge of its members in working out the practical procedures needed. It offers the co-operation of its local sections corresponding to our Provincial Centres and of its members in interpreting this programme to public and private agencies and in stimulating local activity and specific action consistent with the proposed programme.

Industry in America, considered broadly, has not only performed a miracle of war production, but is also exercising most enlightened leadership in planning to meet post-war problems.

Through the Committee of Economic Development and other similar organizations, the best minds in the fields of business, economics and research are developing tangible plans for a prompt conversion from war production to the making and marketing of peace-time products.

A prompt conversion to peace-time production will satisfy the pent up post-war demand for durable and consumer goods growing out of accumulated war-time scarcity and accumulated war-time personal savings.

An essential part of this industrial activity is the alteration or construction of plant facilities to make for most efficient production units in the post-war period. Obviously, the preparation, now, of detailed plans and specifications for such construction will speed up greatly its execution immediately after the war and shorten the period required for conversion to peace-time production.

Conversion of war plants

War production has necessitated a very large expansion of plant facilities. Many new war plants may be suitable for conversion to peace-time production, while others of purely war utility may be ultimately dismantled. Many older plants have become obsolete and will require radical modernization or replacement.

To cope with the rush for work of demobilized men, it is essential that detailed plans for useful public works should be evolved now, even to the extent of detailed drawings, specifications and other essential preliminaries.

Liaison with Officials

On this point I would plead for a little more understanding and confidence as between Government Departments, Institutions like our own and commercial firms of standing. It has been my experience that when Government officers work in close association with representatives of business and engineering firms, far more rapid progress is made than when they work independently, for each materially assists the other. Officialdom is not so impenetrable as is generally believed and in most cases the Government servant is only too glad of help from outside to ease some of his own problems and I do not believe that old fashioned methods and red-tape ideas are any more popular with Government than they are with the man in the street. The trouble seems to me to lie in the lower ranks of Government in the Accounting , Auditing and Clerical Branches which appear to form an impenetrable jungle in which time is wasted and tempers lost.

With common sense playing so great a part in the work of the men at the top, is it too much to expect that Government will once and for all overhaul, what may be termed, delaying departments and ruthlessly root out every form of obstructionist? Theorists are not wanted, even clerks should be forced to go out into the field and into the workshop to learn. something of practical affairs and their attendant difficulties.

No one can tell when this war will end, but it is better to be ready than to run the risk ofa critical period of unpreparedness which may so easily occur.

In the words of Mr. Winston Churchill, "There is not a day, not an hour to be lost," so let us forget the lesser worries, let us smother antagonisms, wordy strife and useless argument and let us resolve to work for the greater things, the better things which will bring credit to our Institution, happiness to ourselves and real assistance, in the time of her need, to India.

Shri H P Bhaumik

Esq., O.B.E., M.LE (Ind.)

Retired Postmaster-General:

Formerly Electrical Engineer-in-Chief, Posts & Telegraphs Department, Govt. of India.

President 1944-45

Presidential Address

Gentlemen,

It is my first duty to tender my thanks to the members of the Council of the Institution of Engineers (India) for having elected me their President for the year 1945. It is a great honour for me, the highest that can be conferred by the Council as representing the Institution on any of its members. I confess my abilities are limited, and I am advanced in age, but in spite of these handicaps I shall not' spare any efforts to justify your choice.

THE WAR.

The great question which is exercising the minds of all of us at the present time is as to when this devastating World War will come to an end. It has wrought terrible havoc and upset the normal conditions of life all over the world. In India, many lacs of people have died as a secondary consequence of this War. Want and privation are stalking the land. Although a few have reaped and are reaping a rich harvest by supplying articles of War, considering the corruption and malpractices which have made their appearance as a consequence, the existence of which has been admitted by people in very high and responsible positions, this prosperity of the few can by no means be considered as a blessing and it is the bounden duty of engineers to sternly set their face against all such questionable dealings whenever and wherever they happen to come across them in the course of their professional business.

Last year, Mr. Kynnersley, our retiring President, made a reference to the Great War and said "We have passed the turning point and the sands are rapidly running out for the enemies of Civilization". Another year has gone by and though substantial progress has been made, recent events show that the enemy is still stubborn and will not easily yield. Greatest efforts and persistent resourcefulness and alertness will be needed to defeat him. We hope and pray that the great task of redeeming the freedom of Europe will be achieved soon. As regards the war with Japan, here also the turning point has been reached, but the enemy is equally stubborn, relentless and treacherous and many months must elapse before the Japanese menace will disappear even after the War in the West has been brought to a successful end. This is the opinion of people in the know, including the British Prime Minister who has definitely warned all and sundry against complacence in this respect.

Such is the situation by which we are now faced. The war of course will come to an end sooner or later and let us hope sooner, than later. It is needless to mention that problems of great importance and intricacy affecting the welfare of this country will have to be properly solved while after-war adjustments will be taking place all over the world.

ENGINEERS & POST-WAR RECONSTRUCTION.

It is necessary for us, members of this Institution, seriously to consider what part we are going to play in the Reconstruction schemes. after the War, of which we have been hearing so much of late. It is a good sign of the time that we are fully conscious of the changes which are sure to come in all spheres of our lives after this World War comes to a close. We must set our house in order if we are to play our part efficiently in shaping the constructive schemes in which the engineers are required to take active parts. In this connection I have great pleasure in quoting from a recent speech delivered by H. E. the Viceroy when he visited Bombay—"In our Post-War offensive against poverty in India, engineers will certainly be in the forefront of the battle; and you may rest assured of my support for the development of the country by hydroelectric schemes, irrigation, road-making and other engineering activities connected with industries and agriculture." This, gentlemen, is a most heartening announcement and we tender our thanks to His- Excellency for this appreciation of the functions of engineers in counteracting poverty in India in Post-War reconstruction.

ORIGIN AND OBJECTS OF THE INSTITUTION

This Institution was brought into being in September, 1920, by the earnest efforts of eminent engineers, most of them being highly placed European engineers, with very laudable objects. Sir R. N. Mookerjee in his inaugural address detailed these, and it is very refreshing to read his illuminating address delivered 24 years ago and I cannot resist the temptation of quoting below a few passages from his able speech:-

(a) "Indians and Europeans are beginning to realise that the development and salvation of Indian Industries depends upon the training of expert Engineers in India."

(b) "We Engineers, therefore, in addition to the actual practice of our profession are also actively interested in the training of the rising generation in India."

(c) "This Institution will, I confidently hope, grow with the advance of time and 'keep pace with the Industrial expansion of India and by its work stand firmly established in the confidence of the people and the respect of the world."

(d) "Though the Institution is a non-political body, it must largely interest itself in administrative and economic questions, and its members should be in a position to assist the State and local administrations such as City Corporations, District Boards and Municipalities in respect of industrial activities and engineering schemes for water supply, sanitation electricity, railways and district roads. It is desirable that engineers should exercise a more effective voice in the administration of the country than has hitherto been the case, and with their specialised knowledge and experience they should not be content with representation in the Councils by men outside their own profession."

(e) "It forms a bond of union between Indian and European Engineers by reason of their common task and traditions as well as their community of interests."

THE ROYAL CHARTER

Later on in 1935, when a Royal Charter was granted to our Institution, the object of this Institution was categorically delineated in 11 clauses in the Charter. These are all known to you, but I feel I must invite your special attention to these clauses once again, with a view to considering to what extent we have been able to fulfil these objects. particularly as regards the training of engineers and also associating with Government of India and Local Governments in the task of developing engineering activities of the country. I must say, with great regret, that our performance has not come up to expectation, and though I am not blaming anyone or any class of engineers in particular I only think that it is very necessary that we must be alive to our duties and our inherent rights, and everyone of us, in whatever capacity he may be working should try his, utmost to fulfil the objects enumerated in the Royal Charter so far as may be within his power to do so.

REPRESENTATION OF THE INSTITUTION IN RECONSTRUCTION COMMITTEES.

Now, gentlemen, is the time for us to be extremely alert and active in our progressive activities. We cannot and must not remain passive spectators of all that will be happening around us without adding our contribution to such practical enterprises, involving the application of engineering in all its branches, as may be launched in the country immediately or in the near future. We have now got over 2,200 members on our roll, and 8 Provincial Centres and a Committee in London. It goes without saying that such a large body of engineers if properly organised can do immense good to the country. The Post-War Educational development in India includes the framing of schemes of Technical Education, organisation of Technical Institutions for the training of Craftsmen, Foremen and Supervisors and also superior Engineers. It is needless to mention that in these matters our Institution is capable of tendering very useful advice as a result of practical experience of its members who come in close contact with the personnel mentioned above.

It is true that the Institution is represented by Mr. B. R. Kagal in the Post-War Reconstruction Committee, and Mr.C. E. Preston on the Association of Principals of Technical Institutions and on the Standing Advisory Committee on Technical Training. In my view, gentlemen, these representations, are not adequate. We should press for greater association of our Institution with all such Committees. Our representatives on these Committees should take very active parts in formulating schemes and should keep the Council of the Institution well informed about their activities, specially because we feel that the importance of this All-India Institution has not been properly appreciated by the authorities.

INTERNAL ORGANISATION OF THE INSTITUTION

I have given very careful thought to this matter, and I have come to the conclusion that we are ourselves mostly responsible for the existing state of affairs. I have to state with regret, that our local centres which should be the most active limbs of our Institution do not all seem to be in intimate contact with local Administrations, nor do they deal with local engineering problems with sufficient elaboration and persistency so as to call attention to the importance of their views. The parent body is no less responsible-that body seems to be more concerned with its routine administration. than the initiating of methods and policies which would enable the Institution to take its proper place in the engineering development of the Country.

It is up to us, gentlemen, to take this matter to heart and to organise ourselves in such a way that the various provincial Governments as well as the Government of India and other bodies will find it to their advantage to utilise the experience and technical abilities of the large number of engineers who are members of this Institution. Indeed I am led to believe that in the earlier years some Local Governments used to consult us and invite our opinions on important matters more frequently than they do at present. With a view to bringing about an immediate improvement we should always aim at perfect co-ordination between members belonging to the different Centres. The Centres should organise their activities in such a way that they come in closer and more direct contact with various local authorities than at present. All internal disagreements should be reduced to a minimum, and all of us should work with united efforts and fulfil the objects for which the Institution was brought into existence and for which the Royal Charter was granted to us. It is not for me on this occasion to formulate individual reforms that should be introduced at once. It is for all of us to put our heads together and draw up plans to rectify the defects in our organisation which militate against the performance of the useful functions of the Institution.

I would, however, mention one matter which concerns the activities of the Institution at Provincial Centres. There has grown up a feeling at certain quarters, that Provincial Centres should act on their own on many important matters such as associating themselves with sister organisations, taking active parts in connection with local engineering developments of various kinds, taking part in all endeavours to improve the technical education and training in provinces, without any reference to the Central Body, i.e. the Council of the Institution. In spite of the good intention of such a move, which I do not deny for a moment, it is my duty. to point out, that ours is an All India organisation and we' must work in a body to gain our ends. We must not do anything which may have the effect of destroying the cohesion and co-ordination of the various branches of the Institution. As I have already mentioned above, I am one of those who strongly believe in making our Provincial Centres live organisations but united and co-ordinated action rather than separate and detached efforts will be more effective, and will be in keeping with the spirit underlying the creation of this All India body. I may assure you, gentlemen, that it will be my endeavour to see that during my year of Presidentship, the Council encourages all individual efforts made by Provincial Centres to fulfil the objects of this Institution, without destroying the unification, co-ordination and cohesion of the main body. It will be the duty of all centres to refer all matters of importance to the Council before definite steps are taken to implement any schemes. The Council on its part will only be too eager to support any efforts made by any Provincial body to advance the cause of the Institution. Surely there should not be any scope for a Provincial body playing against the Central body or the various Provincial Centres playing against one another. There should similarly be no scope for members of Council of one Centre working against those of another or forming groups among themselves and working at cross purposes, sometimes over minor routines, to the great detriment of the real interest of the Institution. I hope, gentlemen, you will excuse me for referring to this rather unpleasant matter, but I am forced by my conscience to bring it up here as I feel that We must be conscious of the danger of divided counsel and must act as a compact body to further the cause of the Institution.

AMALGAMATION OF OTHER ENGINEERING ASSOCIATIONS WITH THE INSTITUTION OF ENGINEERS.

I would, gentlemen, like to invite your attention to another matter with regard to increasing the strength of the Institution. This relates to the question of amalgamation of properly organised sister institutions with our own. By the laudable efforts of the Bombay Local Centre, the Bombay Engineering Congress has lately been merged into Our Institution with the result that there has been a large influx of qualified members into our Institution. I do not see why we should not take similar action with respect to other institutions. In this connection the Indian Road Congress naturally comes to my mind. There are many qualified members of that congress who ought to have primarily belonged to our Institution. Road development in India ought to be a major concern of our Institution. I would, therefore, request all of you to give your careful attention to this important matter with a view to paving the way for the amalgamation of the Road Congress with our Institution.

TECHNICAL SECRETARY.

The need for a Technical Secretary has been and is still being keenly felt by us, but we must be careful as to whom we select for this important appointment. He must be a capable engineer of broad views and fairly high status, and considerable experience both Technical and Administrative. Such a man, I am afraid, cannot be obtained on a paltry sum of Rs. 300/- or 400/- per month. We must pay him well, and I would like to designate him as the General Secretary of the Institution. We have very unfortunate experience of a Technical Secretary we appointed a few years ago, and in my view, we did not obtain full value of the money we spent and in addition suffered considerable worries as a result of friction caused by his method of performing his duties. Such a danger must be avoided in our future selection. The Technical Secretary, or as I would like to call him the General Secretary, should be a man capable of running the affairs of the Institution on approved lines. To make him a mere counter-part of our present Secretary who is quite experienced and capable of managing the ordinary routine affairs and accounts, etc., of the office, will be a serious mistake.

POST-WAR TECHNICAL EDUCATION-Superior Engineers.

I would now draw your attention to some fundamental problems which affect the profession of engineers in general, and 'of the members of this Institution in particular. The first and foremost among them is the question of introducing the proposed system of Technical Education for the whole of India. It will embrace the training of (i) Superior class of Engineers (ii) Foremen and Supervisors and (iii) Craftsmen, Artisans and similar other engineering operatives. The class which mainly composes our Institution belongs to the first category. Much has been said and written about the theoretical and practical training of all the above groups. Most of you, I am sure, have studied the report of the Central Advisory Board of Education on the Post-War Educational Development in India, popularly known as the Sargent Report, particularly those chapters which relate to Technical Education. In the very beginning, gentlemen, I must admit that I am profoundly impressed by the elaborate nature of the scheme of Technical Education for India propounded therein. Possibly the scheme is very complete and presents an excellent ideal picture of what technical education should be like in India, but how many of us believe that the scheme can be given effect to in the near future? Apart from the question of financial implications, there will be other complications as the existing framework of technical education in India has not been fully taken into consideration. One remarkable feature of the scheme is that Civil Engineering training has received scant attention. This branch of engineering has progressed most in India and in certain branches of Civil Engineering Indian engineers can show remarkable performances to their credit. The scheme presupposes that there will be a very large industrial development in the country immediately after the War and these industries will be keen on the training of the engineering personnel and will not hesitate even to bear a share of burden involved in training them. The fruition of the proposed scheme of technical education involves. the introduction of Basic Education, establishment of Technical High Schools, Junior Technical, Trade or Industrial Schools, Senior Technical Institutions and several plans of part time and whole time instructions. In addition the Universities will continue to function to produce the superior classes of engineers as at present with some modifications of the methods of teaching. The scheme is naturally based on the system in vogue in England but you will excuse me, gentlemen, if I express my doubt as to whether a system imported from England where conditions are not identical with those prevalent in India will meet our requirements. Above all it is neither possible nor desirable to scrap all the indigenous institutions which have grown up in the country and which impart technical education to those who have offered themselves for such training. Evolution and not Revolution should be our aim. I am not unaware that in certain malignant diseases the affected part or parts should be straightway amputated if the patient's life is to be saved. I do not think, gentlemen, that we are in such a desperate position. We must surely do away with illiteracy among Craftsmen, and introduce compulsory basic education for all. We must also reorganise the high schools so that the would be engineering students will be better equipped for their future education in Engineering Institutions. All these reforms ought to have been started long ago. I am glad that the problem has. come to the forefront in connection with our schemes for Post-War Reconstruction.

With regard to details I shall confine myself to expressing my views only on certain points which are also shared by several members of the Institution with whom I have discussed them. As far as the technical part of the educational system is concerned, we have in the scheme as I have already mentioned before, the training of following classes of personnel in view :-

(1) Superior class of Engineers

(2) Foremen and Supervisors

(3) Craftsmen, Artisans and Operators

A very detailed, comprehensive, and to my mind, somewhat complicated system of training these different kinds of personnel has been proposed in the scheme. The system of granting National Certificates and National Diplomas has been recommended to the students trained in Senior Technical Institutions. Most of the training proposed to be given by those Senior Technical Institutions can be and is now being practically imparted by engineering colleges established by (1) different Universities and also (2) by private agencies and by Local Governments. Under the second head can, for example, be mentioned the Jadavpur Engineering and Technological College in Bengal, the Technological Institute in Bangalore, the Victoria Jubilee Institute in Bombay and the Thomason College, Roorkee. These colleges cannot disappear and they will exist side by side with the proposed Senior Technical Institutions. Then again I am not sure whether those proposed Technical Institutions will cater for training in Civil Engineering. Obviously one of the reasons for starting these new Senior Technical Institutions is to give the training an All-India character, presumably on the plea, that an All-India Diploma will enable the holder to obtain employment any where in India irrespective of the province where he was trained, whereas the holder of a University degree would only find employment in the province in which that particular University is located. This argument is more theoretical than practical. Whatever Diploma or Degree the holder may possess, a Bombayman will for example have greater chance of employment in Bombay than in the Punjab and vice versa provided both are equally qualified. Moreover at the present time, there is a tendency for the curriculum of studies in all Indian Engineering Colleges to become uniform, so the difficulty on account of diversity of standards will continually decrease. This fact is bound to be appreciated by employers of engineers with the progress. of time. The Senior Technical Institutions are meant to be parallel organisations to the Universities, and the University College trained engineers will have in practice to compete with the National Diploma holders. I would ask you, gentlemen, to consider whether this duplication is necessary. In my view the most urgent need of the country is the establishment of Poly technical Institutions of the type of M.I.T. of America (not mono-technical institutions-they will not meet our needs). It is also necessary to expand the existing University Colleges and other privately owned or Government Institutions and to transform them into full fledged Poly technical institutions. They may function either within or outside the ambit of the Universities though I would certainly encourage their affiliation with Universities wherever possible, but their syllabuses of studies and methods of teaching should be fully co-ordinated. Special committees should be formed to supervise the training in different branches of these institutions. The Institution of Engineers which is an All-India body and other All-India Associations such as the Association of Principal of Technical Institutions ought to take an active part in formulating schemes of training in these colleges. The practical training has in any case to be given to the students of these institutions in workshops owned by big industrial firms including the Railways. This cannot be arranged without active intervention of the State, i.e. the Government of India and the Provincial Governments. At present it is most difficult for students of engineering to get this training. I am saying this from practical experience. The students after passing out from their colleges find it difficult, if not quite impossible, to obtain proper practical training in industrial workshops. The practical training may be given by the Sandwich system or other suitable systems in which the theoretical and practical training are given according to plans which have to be worked out by keeping in view the requirements of particular institutions, their locations with respect to industrial workshops, and other relevant factors.

The Universities which have hitherto produced many of our eminent engineers appear to have been treated in a step-motherly fashion in the Board's Report. There appears to be a feeling that the Indian Universities do not pay sufficient importance to engineering education, they are more concerned with academic education. This may be true of certain Universities, but there are other Universities of which the main plank is engineering education. Some Universities are at present very keen on starting engineering colleges and getting our recognition of them for exemption from 'A' and 'B' examinations for the passed students of those colleges. In brief, gentlemen, the idea is that the Universities should be strengthened and expanded and made to impart more efficient technical instructions and our Institution should take active part in hastening the process. I may be wrong and you may consider me out of date, but my conviction is that the starting of Senior Technical Institutions as parallel organisations to the Universities (which in actual practice they will be) will lead to unnecessary complications in developing higher engineering education in the country. I am tempted to make one remark in passing regarding the complaint that our engineering students have an inordinate love for Degrees. I think this is not a peculiarity with our students alone, it prevails all over the world. Had it not been so there would not have been an abundance of degrees such as B.Sc. (Eng.), M.Sc. (Eng.) Ph.D. (Eng.) D.Sc. (Eng.), and similar other titles in Europe and America

TECHNICAL EDUCATION-Craftsmen and Supervisors.

There remains the question of training Craftsmen and Supervisors. As regards Craftsmen, those institutions for training War technicians which have either been brought into existence or were already in existence should as has been suggested in the Report, continue to be utilised for this purpose. In Bengal, for example, there are quite a number of industrial schools and technical institutions where training is given in different Crafts. They not only produce Craftsmen, but also personnel of the Supervisors or Foremen class. The Provincial Governments can systematise the training of students in these institutions through their Education or Industries Department in close collaboration with industrial firms including Railways which employ them. These institutions will correspond to the junior technical schools of the Advisory Committee's report. Gentlemen, it is not necessary for me to further discuss these matters. It cannot be done, even if I wanted to do so, in a Presidential Address. All I would like to impress on you, is that in a country like India, where we have our special needs and where the conditions differ widely from those of European countries it will be extremely unwise to transplant any European schemes in toto and abolish or scrap whatever we have got and which have given us service in the past. In this matter, I believe in improving and expanding according to needs than in the wholesale demolition of the old and constructing a new. The time factor has also to be considered. We must achieve results quickly. It is very de pressing to think that we have to wait 40 years before we can see the materialisation of the schemes. God knows what will happen in 40 years. Let the long term schemes be considered, but side by side we have also to think of some short term schemes as we all want to obtain substantial results in 5 or 10 years after the cessation of hostilities. This is not an utopian idea. The example of a vast country like Russia is before us and we cannot help thinking that with determination and earnest efforts, much can be done within a comparatively short period. Before leaving this subject I must once again ask you, gentlemen, that we should strive our utmost to make our importance and usefulness felt by the authorities in the task of placing technical education of this country on sure footing. Our body should take an active part in devising schemes of engineering education in Post-War Reconstruction.

ENGINEERING RESEARCHES.

The above remarks apply with equal force to various other engineering activities one and a most important one of which is Research in Civil, Mechanical and Electrical Engineering. There is immense scope for such work in India, but very little has been done so far. Here again it is the State which should initiate the projects and those industrial firms which are in a position to do so, should assist by substantial contribution of funds, for it will directly benefit them no less than the general public. Then again there is the question of Standardisation of engineering practices. This is a matter in which the Institution ought to have already taken a leading part and should have established its claim to be a competent authority for the whole of India. I am however, glad to inform you that in a recent meeting of the Industrial Research Planning Committee held in Calcutta, presided over by Sir Sanmukham Chetty, the Institution was asked to send our representatives to help the members in their deliberation. Two members of Council attended the meeting, and were able, I am informed, to convince the members that ours is a competent body to guide and supervise engineering researches and also take a leading part in the drawing up of standard specifications for engineering practices for the whole of India.

DEVELOPMENT OF ELECTRIC POWER-Hydro-Electric Schemes.

Gentlemen, as an electrical engineer, I presume you will expect me to say something in connection with the development of electric power in this Country. The outlook here is also far from encouraging. Very little of the abundant natural resources available in the country has so far been utilised. In the beginning of my address I referred to the hopeful assurance of His Excellency the Viceroy that he would give his support to the establishment of Hydro-electric schemes and other engineering projects as measures of Post-War offensive against poverty. We all should welcome this announcement and would look forward to a substantial advancement in the supply of electric power for various nation building activities. In this matter systematic planning ought to be started at once to discover what resources we possess in generating electric energy both by the Hydro-electric and the Thermal methods. There are great possibilities for developments and the abundant natural resources of the country have not been at all sufficiently tapped. The available water power of the country has been differently calculated. Mr. Mears put it down between 12 and 13 million K.W., but my own impression is that it will be considerably more than the above figure. There is an argument r have often heard from many responsible people that unless industries are developed we cannot make use of electric power to any appreciable extent. At the same time I have heard that industries cannot be developed in many places for want of power: This is arguing in a circle. In this matter India ought to take lessons from countries like Russia and America. The new regime in Russia saw at once that unless power was developed it was not possible to make the country prosperous, and power development took an important place in the planning activities of that country in the very beginning.

Mr. Kynnersley in his Presidential Address last year referred to the development of T.V.A. (Tennesse Valley Administration). It was true there was great opposition and hostility to the scheme but all these were overcome and President Roosevelt's personal interest was a main factor in the ultimate formation of the scheme. There is a river flowing through the Provinces of Bihar and Bengal which resembles the Tennessee river in its essential characteristics. It has many a time caused great havoc to the country-side, by washing away villages, killing cattle and human beings ana destroying cultivation. Many ideas were propounded to put a stop to this recurrent evil, but so far not much has been done. We have read learned discourses about terracing, afforestation and the like. The latest development was the formation of a Committee consisting 9f Physicists, Hydraulic Experts, Irrigation Engineers and others who investigated the matter and submitted their report. No body yet knows what action will be taken, but an electrical engineer cannot help feeling that there is a great opportunity of developing electric power by the proper training of this river. I have recently heard that the Report is receiving the careful consideration of the Government of India and that it is not impossible that a regional Administration will be formed to implement a well planned scheme on the lines of T.V.A. By the construction of proper barrages, reservoirs and irrigation channels, this river can be made to yield possibilities for the establishment of various industries, agricultural, chemical, electrical, etc., which will certainly constitute a real offensive against poverty of the locality concerned. May we hope that like President Roosevelt, His Excellency the present Viceroy of India will exercise his personal influence for bringing the Damodar River Scheme to speedy fruition. This is not the only river in Bengal which with proper training and scientific handling can be made to yield substantial wealth to the country. There is the River Teesta at the foot hills of the Himalayas. One has to visit the river by taking a trip from Siliguri to Kalimpong Road on the Darjeeling Himalayan Railway to grasp the immense possibilities of this river. There are other rivers also in Bengal some of which are dying for want of proper care which can with proper scientific handling be made to develop power and increase the wealth of the country-side, improve the health of the people, and save them from starvation and disease,—a direct result of their intense poverty.

POWER DEVELOPMENT—Thennal Schemes.

Apart from the Hydro-electric schemes, Bengal and the adjoining Province of Bihar possess resources for installing large size Thermal stations for the generation of electricity. It is sad to reflect that no substantial efforts have so far been made by anyone to implement any such schemes. A very suitable place for the installation of such a station which comes to my mind is Jharia. This is now within the Province of Bihar. With Thermal stations in the Coal fields and Hydro-electric stations in Bengal, both the provinces of Bengal and Bihar can be flooded with electric energy by means of properly designed grids. This will materially help in the development of industries both large and small. With the availability of cheap -power, industries can be decentralised all to the benefit of the people of the country. I have taken the example of Bengal and Bihar as I am more familiar with conditions there, but my remarks generally apply to all provinces in India where possibilities of development of electric power exist. In my opinion special regional Administrations have to be created for the planning and implementing of big power development schemes, and provincial Governments should be made to co-ordinate with one another in fructifying the same. I understand that the Government of India have expressed a desire to establish a Central Technical Power Board to deal with these important matters. This is certainly good news. The sooner this board begins to function, the better it will be able to serve the interest of the country. Certain provinces in India have made considerable progress in this sphere and we should congratulate Madras including the states of Mysore and Travancore, and Bombay as the two foremost provinces which have been pioneers in this field and are still going ahead with developments and projects. Time does not permit me to dilate on this subject, but I may draw the attention of members to the excellent paper on Planning for Post-War Electric-Power by Mr. Vaidya. Many of you, gentlemen, must have read this paper and taken part in discussions on it. This paper gives a detailed account of the state of development of electricity in India and you will again have an opportunity of discussing this paper and the author's ideas during the course of the present session. You may ask how the members of this Institution can help in all these matters. I have only to say in reply that they can do so by writing papers such as Mr. Vaidya's, discussing them and giving wide publicity to our ideas, and even pressing our points of view to the notice of the authorities who are in a position to help in implementing development schemes. This duty can never be abrogated by us if we are to prove to the world and particularly to the Indian World, that ours is a body created for the purposes of imparting help in expanding engineering knowledge and thereby enhancing the engineering and industrial activities of the country.

DEVELOPMENT OF TELECOMMUNICATION.

I would also like to refer to a special branch of Electrical Engineering known as Electrical Communication Engineering in which I had the privilege of working during my official service under the Government of India. This branch of engineering has a very interesting history in this country, into the details of which I cannot enter on this occasion. Suffice it to say that it has made phenomenal development during the last 20 years. Among other things, networks of Trunk Telephone circuits including multichannel carrier Telephone and Telegraph circuits were already established prior to the War. Developments were going on though slowly as it was not always easy to procure equipments to suit the needs of the country from outside India. On the advent of the War, the electrical communication system was naturally transformed into a War-necessity and great attention had to be paid to it. Trunk Telephone Circuits had to be multiplied several times on many routes, new routes had to be opened and many crores of rupees were spent and are being spent to improve the electrical communication system of the country. This is all to the good as on the conclusion of hostilities these circuits forming links between important centres will be helpful to the growth of industries. We are, however, still lagging far behind other countries in providing facilities for Electrical Communication in India. Only a very small percentage of our population takes advantage of them. Without growth of industries Tele-Communication systems of the country will not be fully developed. In this matter a certain amount of forced development will be of great value. The present World War has given a strong impetus to its growth. In this development also, India ought to be self sufficient so far as the manufacture of equipments is concerned. Not much progress has been made, but the results obtained, though limited in extent were quite satisfactory from the technical point of view. Much is made of Indian Craftsmen being illiterate. Most of them are so in the sense that they cannot read and write English properly, but a very large percentage of them can read and write their mother tongue and there are great many experts in their own special lines of work. This is not a theoretical argument. I am saying this from my practical experience as I was in close touch with the Government Telegraph Workshops for many years, and after my retirement from service, I had connections also with the Jay Engineering Works, a big engineering workshop in Calcutta. We manufactured high speed precision Telegraph instruments in the Telegraph workshops in Calcutta besides a multitude of Telephone and Telegraph instruments and fittings. The good quality of the work attracted the attention of the representatives of foreign manufacturers. I again plead that in our attempt to introduce a new scheme of education, these classes of mechanics and artisans should not be destroyed. Their abilities should be expanded and in the new framework they should be made to fit easily. This is not an impossible task, and will be entirely beneficial to the industries where these men are now employed. Sufficient facilities do not exist now in our technical institutions for the training of personnel for this class of work, but here also the Institution of Engineers can help by tendering advice to such of the institutions as have made provision for imparting proper instructions in their curriculum. There are several such institutions in the country.

OTHER ENGINEERING ACTIVITIES.

There are other spheres of Post-War Planning in which the engineers should be on the front line and this Institution ought to identify itself fully with activities connected therewith. For instance it is reported that a large expenditure of Rs. 400 crores has been contemplated by the Government of India on Road Development, and Rs, 300 crores for expansion of Railways in India. I have heard criticisms that unless the planning for these various activities is correlated and proceeded with more or less simultaneously, satisfactory results will not be obtained. This is in my view true in a general way. Take for instance Railway and Road Building programmes, they must be co-ordinated. We used to hear a great deal about Road and Railway competition in the' past. That difficulty ought to have disappeared with the acquisition of practically all Railway systems. in India by the State. In Bengal, consideration will also have to be given to her river navigation system. This is intimately connected with the future Road and Ralway projects in that province. In all these matters the Government of India will have to take the lead and the Provincial Governments will have to make co-ordinated efforts to render all schemes successful in their respective provinces. The technical details will necessarily remain in the hands of engineers and they must fulfil their primary function towards implementing these schemes. In this connection I would invite the attention of all members to a booklet published by Sir Visvesvaraya, an Honorary Member of the Institution, which deals with-Post-War Planning and Economic Organisations. I am sure, gentlemen, you will find ample food for thought in that booklet which cannot be overlooked by engineers interested in the Post-War development of Educational, Industrial, and Economic schemes which will be of real benefit to the country.

In conclusion, gentlemen, I must thank you for the patience with which you have listened to this address. I would again, before taking my seat, stress the point that no real advancement of the country by the development of its natural resources can materialise until and unless all projects are actively supported and pushed on by the State. Indians are indeed very poor with a paltry annual income of Rs. 65/- per capita, but India is a rich country — rich in natural resources — awaiting to be developed to make its inhabitants happy and prosperous. We the members of the Institution of Engineers ought to be thankful if we can by our combined efforts -add a little to the speeding up of the process.

Shri H P Bhaumik—a Brief Profile

Shri Hari Pada Bhaumik, O.B.E., B.Sc., C.E., M.I.E., who was President of the Institution for 1944-45, died at his residence in Calcutta on April 28, 1959. He was 77.

Born in 1882, Shri Bhaumik took his B.Sc. degree in mathematics from the University of Calcutta and graduated in Ci vi] and Electrical Engineering from the Thomason College of Engineering, Roorkee, in 1905. He joined the Indian Posts and Telegraphs Department as Assistant Superintendent in 1905. He was promoted to Superintendent of Telegraph Engineering in 1916, and later rose to be the Electrical Engineer-in-Chief. During his service, he was directly responsible for many important technical projects such as the inauguration of carrier current telegraphy and telephony in India, installation of several long distance telephone lines in the country, laying of a continuously loaded submarine telegraph and telephone cable between India and Ceylon across Palk Strait, and the introduction of the international oversea telephone link between India and the United Kingdom. He was also responsible for the design, installation and maintenance of all the special apparatus or the projects undertaken during this period. He retired from service as Post Master General, Madras, in 1936. In recognition of his distinguished services he was awarded the Order of the British Empire in 1934.

He was Dean of the Faculty of Engineering, University of Calcutta, for two terms, and also a member of the University Syndicate and Senate. Shri Bhaumik joined the Institution as an Associate Member in 1932 and was transferred to Member in 1935. He was the Honorary Secretary of the Bengal Centre during 1937-38 and the Chairman of the Centre during 1938-39.

A message of condolence and sympathy was sent to Shri Bhaumik's family on behalf of the Institution. The Headquarters of the Institution was closed on April 28, 1959,as a mark of respect to his memory. At the meeting of the Council at:New Delhi on May 16, 1959, the Council, before commencement of the proceedings, stood up and observed two minutes silence, and also passed a resolution of condolence for communication to the bereaved family.

Nawab Zain Yar Jung Bahadur

President 1945-46

Presidential Address

Gentlemen,

It is a matter of privilege for me and my first and most pleasant duty to express my thanks to the Council of the Institution for the signal honour they have done me in electing me as their President. It is a matter of great pride for me to take the Chair which such distinguished Engineers as Sir Thomas Ward, Sir Rajendranath Mookerjee, Sir George Willis, Sir Clement Hindley, Dewan Bahadur Ramalinga Iyer and last but not least my own predecessor, Mr. Bhaumik, have occupied in the past. They and those who followed them have built up the present Institution of Engineers. It is indeed a privilege to succeed them in this office and to hold it at a time so important as the present and so consequential in the history of Indian development.

This Institution was established in India at the end of the first Great War. Twenty-five years have thus passed since its inauguration-years of experiment and research, of trial and error, of changes and convulsions in our social and economic life. Today, at the end of the most disastrous war in history, we find ourselves faced with problems, both economic and social, of unsurpassed magnitude. I feel that in their solution the engineers of India must and will take a leading part. They owe it to their profession, to their training, to the very conception of Engineering, that they should do so. Indeed, there can be no better prospect of real service for the followers of a vocation so essentially constructive as the profession of Engineering than the vast field of reconstruction which lies open before them today.

Economic and social plans have been discussed and presented by several authorities in India. There are the Government of India's own Plans, the Bombay Plan, the People's Plan, tile Nehru Plan, and others, all dealing with the same question, having more or less the same objects, though perhaps different in approach. The first proposals for a ten years' plan of development were formulated by one of the foremost Engineers of India, an Honorary Member of this Institution, Sir Visveswarayya. In his book, *Planned Economy for India*, he has given a picture of the constructed India of the future in the following words :-

"Two or three new, heavy basic industries, owned by large public companies or firms or by local Governments themselves, will have to be established in every Province. Many medium-scale industries and a great variety of minor and cottage industries will have sprung up. Agriculture will have come to be more profitably practised on scientific lines. Many new reservoirs, large canals and numerous minor tanks will have been built and model farms established amidst expanses of smiling fields. Transport and travel facilities will have been greatly extended. Thousands of miles of new roads have been laid out and old ones improved, particularly in rural areas. The railways and air services will have been greatly extended, and the engines, machinery and plant required for them supplied from factories successfully operating within the country. Many new hydro-electric plants will have been installed and the country covered with a net-work of wires carrying electric power all over the land for lighting, industries and lift irrigation".

Some have called this the Engineer's dream. In our own day, however, we have seen dreams come true. The dream of American Engineers and Planners has been transformed into reality within a few decades in the Tennessee Valley. The critics of Sir Visveswarayya may well be told that Engineers are not day-dreamers, that they combine vision with realism, planning with science, imagination with all the reality of machines and tools, dimensions and measurements, brick and stone and mortar and not just straw or sand. It is indeed, in my view, fortunate that no national plan can in essence be executed, or in fact even conceived, without the Engineer. And is it not true that much of the criticism levelled against the alleged unrealism of such plans is based upon a view which is influenced largely by the present standard of living and the present low national income and needs? The authors of the Bombay plan have supplied a corrective in the following words :-

"If we are going to develop our resources according to a pre-arranged plan, we should certainly not be satisfied merely by providing for every person the minimum requirements of life. A planned economy must aim at raising the national income to such a level, that after meeting the minimum requirements, every individual would be left within enough resources for enjoyment of life and for cultural activities". That view was supported by His Excellency the Viceroy when he said :- "The views of the authors of this Plan on the objects to be achieved are in principle the same as those of my Government. We must work for a substantial increase in standard of living and social welfare ".

To take the Bombay Plan alone, the execution of 66 per cent or two-thirds of it will lie within the province of Engineering. I have not taken into account such items as Agriculture, Education, Health, General and Consumption Goods Industry. Even in relation to these matters, such as the prevention of soil erosion and soil conservation, land drainage and reclamation construction of educational buildings, clinics and hospitals, water-supply and sanitation, can only be dealt with by Engineers. Taken as a whole, nearly 75 per cent of any scheme of planned economy will need the talents, the mind and the application of the Engineer.

As Sir Ardeshir Dalal has recently said :-

"the post-war period to which we have so long looked forward has now ceased to be a mere point of time in the future. It has become present reality ".

Nevertheless, there is a widespread, feeling that post-war plans have so far made very little progress beyond the stage of initial consideration. There are parts of India where schemes are said to be still at a tentative stage. The pace has to be accelerated and, for that, co-ordination between the Engineer and the Administration is most necessary. One of the urgent problems of today is the question of re-employment of demobilised personnel and industrial workers so far engaged in war factories. Those factories have themselves to be converted to a peace-time basis. There is also the problem of reconditioning and replacement of war-worn machinery.

Works, such as Buildings, National Highways, Irrigation and Hydro-electricity will not only provide direct and indirect employment but will also, in time, become permanent centres of production beneficial to the health and welfare of the people. But where even money and labour may readily available, the absence of construction plant and machinery in be market, the scarcity of materials such as cement, steel, tools, and the lack of adequate transport facilities come in the way of smooth or speedy development.

The question of priority is fraught with difficulties. There are the demands of various interests, both regional and otherwise, which remain to be reasonably satisfied. So far as schemes of development are concerned, I have no doubt that Irrigation and Hydro-electric power must occupy the highest priority; they are essential for meeting our food requirements and the power generated from irrigation works would help the development of Industry, both large and small. In the whole of India, including the States, an area of 362 million acres is cultivated out of a gross total of 1,000 million acres. The total area irrigated from all sources in 1937-38 was only 65 million acres or roughly 18 per cent of the total acreage. The remaining 297 million acres depend on a precarious rainfall. Even if allowance is made for spaces that may be unsuitable for irrigation, there would be ample land available which could be watered on scientific lines. The irrigation works of the future are, however, likely to be more costly than schemes formulated in the past because, firstly, the rates of construction will remain at a high level for a considerable time in the post war period and, secondly, the economical sources of water have already been exploited and the irrigation works of the future will have to be in the shape of storage reservoirs. So far as Hydro-electric power is concerned India has immense resources. Out of a potential total of about 27 million horse-power, the power actually developed is in the neighbourhood of about 3 per cent of that total. The general pattern of an all-India grid needs to be determined and the regional grids have to fit into that pattern, This would enable Hydro and thermal co-ordination to be utilised to the fullest advantage. The present lack of positive and final information with regard to the sites and magnitudes of load centres need not prevent the planning of a future grid so long as the design is made elastic enough to be modified according to future requirements.

I should like here to draw special attention to one aspect of post-war planning, namely, the effective control and utilisation of rivers. If only one could fully realise the advantages of an easy access to water it would not be difficult to understand why each State or Province so jealously guards its water-ways. Instances are not lacking of deadlocks over schemes of utilisation which have lasted for well over half a century. During that time, a great amount of water has been allowed to run to waste and to cause havoc. A series of Inter-State Commissions of technical experts, one for each basin, may help to reach decisions in the best interests of the different parties concerned. The Commissions should consider all schemes, not on an individual basis, but as a whole and on the broad principle of the greatest good of the greatest number. The settlement of all pending disputes. In this sphere will lead to the provision of cheap Hydro-electric power for industrial development and also afford facilities for cheaper communication through navigation.

I should like to say here a few words with regard to Engineering research. I need hardly stress the importance of fundamental research for the progress and development of a profession such as ours. Universities in various parts of the world like United Kingdom, America and other countries have made many valuable contributions to the fundamentals of Engineering Science and it is for us to follow their example. One of the most vital functions of a University is to provide adequate facilities for research and the aim of each student should be not only to gain higher knowledge in his profession but to extend and explore that knowledge for the benefit of his fellowmen, I firmly believe that students of Engineering engaged in research work should not confine themselves merely to theoretical principles but should be ready to grapple with problems that confront them every day in the field of practical Engineering and which need immediate solution. It is often in the attempt of solving a problem of this kirid that a new principle or method of Engineering is discovered which becomes a boon and blessing to man .

I therefore suggest that our Institution should invite the attention of the Universities in this matter and recommend that Engineering Colleges should receive their encouragement and support in conduct long-range fundamental research in the laboratories and that their requisitions for equipment, finance and personnel should receive sympathetic consideration. An appeal of this kind coming from this Institution will, I feel, provide the necessary stimulus to all the Engineering Colleges in India and will result in an incentive to fundamental research' Engineering .

Now that hostilities have ceased we are confronted with the problems of peace. India is, I am glad to say, becoming increasingly research-minded and research Institutes are being established to deal with the various problems of Engineering as-they arise. Bat if such Institutes to flourish and increase in numbers they will need trained personnel to do the vital work of instructing the novice, the student in the work of research. Our Universities should therefore provide facilities for such training.

Dr. McLean in his admirable work on "Regional and Town Planning" has observed that "in countries where development is not advanced as in parts of Africa, when large undertakings are carried out, such as railways, roads or irrigation works, their comparatively sudden introduction seems usually to change the whole economic life of the region and to entail many other problems of development which need to be considered at the same time. For example, the construction of the great irrigation works in Egypt and in the Sudan, and also the construction of the railways and roads there and in other parts of Africa, has had this effect, and the standard of living of the people has been raised comparatively rapidly. Whether development be slow or fast, it is essential that all phases should be planned in advance. Systematic planning on a regional basis is increasingly recognised as an important factor in promoting the prosperity and health of the inhabitants, These regional schemes, while they serve as the groundwork for the town planning schemes, also assist in determining the extent and the nature of the development which may be expected, and the provisions necessary for communications and transport electricity for lighting and power, commerce and industry (including zoning), minerals, agriculture, water-supply, drainage, housing and open spaces". Side by side with plans of economic development, I feel it is vitally important also to prepare schemes of regional and town planning. Fortunately, as far as town planning is concerned, there has lately been an awakening of interest. People have come to realise its place in life. A matter of far-reaching importance, and one which may be regarded as forming the background of the lives of the industrial and the agricultural workers, is the question of housing.

The general standard of industrial housing in India is extremely low. There is overwhelming evidence to establish the direct connection between congestion in cities and the rapid spread of respiratory diseases. In the interest of the workers' health and the health of the population as a whole, house building on a large-scale, specially in the cities, is an urgent necessity. The growing industrial population and the call for better standards of living are making such large demands on the building industry as can be met only by the application of modern scientific methods. Design has to concentrate on cheap, comfortable and sanitary dwellings. What we need in India and need urgently is an organisation like the National Bureau of Standards at Washington, with a section devoted to research in Building and Housing problems.

Housing has two aspects: the provision of new houses on clear sites, and slum clearance which, in other words, means re-housing. In some towns in India, slum clearance has only meant the replacement of old by new houses which are mass-designed. In most cases, this has amounted to giving the inhabitants the equivalent of future slums, of a somewhat modern type perhaps, but with insufficient courtyards or open spaces. It is necessary to consider the question of overcrowding, whether we clear slums or develop open areas. The chief problem of our slums is the problem o f overcrowding, not only overcrowding of too many houses in a small area but overcrowding of too many people in a small house. It was found in 1921 that, out of the total population in Bombay, as much as 70 per cent lived in one-roomed tenements with an average of a little more than 4 persons in a room. In one section of the city, the percentage of population living in one-roomed tenements was 96. Conditions in other industrial centres, such as Karachi and Cawnpore, were found to be equally bad, if not worse. The result has been that no settled factory population has grown-up in industrial centres, and there is consequently periodical migration of labour between the town and the country.

There is the further problem that, in many industrial centres where land is exceedingly valuable, the workers are forced by circumstances to live in gloomy, congested tenements with primitive sanitation, having little or no light and even poorer ventilation. In other cities, where open spaces are available, the conditions are hardly better. These facts have been cited over and over again by almost every Commission and Committee appointed by Government during the last twenty-five years to examine this question. No landlord in any country can be expected to be such an undiluted philanthropist as to provide adequate and healthy houses free of rent or at reduced rates to people who cannot afford to pay. What then is the solution'? An alternative advanced is that the wages of the industrial worker should be raised. True, but the question remains as to whether the responsibility of the Architect and the Engineer ceases upon designing and constructing the tenements at the behest of the landlord? Is it not their duty to protest emphatically, in Municipal Councils, on the platform and in the press, against such conditions? Several benevolent and far-sighted employers such as the Tata Iron and Steel Company at Jamshedpur, the Giridih Collieries, the Empress Mills at Nagpur, Batanagar in Calcutta and a few others have carried out housing schemes on advanced, scientific lines. The Labour Association of Ahmedabad and the Coal Mines Welfare Advisory Committee of Raniganj and Jharia have also done commendable work in forging ahead with schemes of housing estates

for the textile and coal workers. But what percentage of the total industrial population of India is housed in such tolerably well-equipped colonies with good roads, decent schools for boys and girls, parks and playgrounds medical relief, water-supply, drainage, lighting and labour welfare?

Planning for India resolves itself, to employ a phrase used by the late President Hoover, into the creation of "a national engineering sense of provision for the nation as a whole". Vast as India is, the problem of planning her economy is vaster, if only because of the lee-way she has to make in point of time and standards. Our Engineering conceptions have accordingly to be enlarged on a national scale, and what we need, both literally and in the wider sense, is in fact "National Engineering" Governments and Administrations must on their part realize that Engineers are the "steel-frame" of development and that the complete consultation and co-ordination is required between the Administrator and the Engineer. That is why the Institution of Engineers represented to the Central and Provincial Governments and to the Indian States that they should include in their administration, consistently with their statutory provisions, suitable Engineers of administrative experience for the management of communications, posts and telegraphs, irrigation, power, industries, rural, reconstruction and similar other activities requiring the help, the precision and the talents of the Engineer.

The demand for a planned economy is in reality a demand for assurance that a reasonable standard of economic life will be afforded every individual, however poor. It is the time-old quest for a happy, clean and a secure life. Since his earliest days, man has endeavoured create such a world for himself. Some times the frontiers of faith knowledge have been pushed back and, with them, the ideal of collective good. At other times vigorous men have appeared, accepted the world and endeavoured to serve and rebuild. Today, after a terrible period storm and stress and destruction, the world and its peoples are faced the problem of rebuilding and rehabilitation. That problem confronts not only those countries which have been reduced to ruin by human hands which brought no, other gifts than death and destruction, but also those lands, like ours, which are assailed by the deadlier enemies of poverty ignorance and disease. We have, therefore, to rebuild and reshape the whole of our national life, and we could take no better resolution on this occasion of the Silver Jubilee of this Institution than to pledge ourselves to attack, with all the tools and implements, the machinery and equipment, the mind and the imagination of the Engineer, the triple alliance poverty, ignorance and disease which holds our country in its reIentless grip.

Nawab Zain Yar Jung Bahadur—a Brief Profile

Syed Zaimuddin Husain Khan Nawab Zain Yar Jung Bahadur, F.I.I.A., M.I.E., died on May 16, 1961, at the age of 72.

After receiving his early education in the Nizam College, Hyderabad, Nawab Zain Yar Jung proceeded to England in 1908. He obtained the Diploma in Civil and Mechanical Engineering from the Crystal Palace Polytechnic, London, in 1911, where he earned also the distinction of being a hockey blue of the University of London. On his return to India in 1912, he joined the Nizam's Public Works Department as Assistant Engineer in the Irrigation Department. He made his mark in the construction of the Osmansagar Reservoir project and in furthering the schemes of beautifying the city of Hyderabad proposed by Sir M. Visvesvaraya.

In 1922, he was promoted to Executive Engineer. In 1930, he was nominated by the Nizam's Government as Architect for the University buildings, and was deputed to tour in Europe, America and Japan to study the designs of important universities of the world. On his return he was appointed State Architect in 1932. He was Commissioner, Hyderabad Municipal Corporation, from 1935 to 1938, in addition to holding the post of Chief Architect, Nizam's Government.

He was appointed a Minister of H.E.H the Nizam's Cabinet in 1944 and held the portfolios of the Public Works and Commerce & Industries Departments. He continued in this capacity until 1948 when he was posted as H.E.H the Nizam's Agent in New Delhi. After the police action in Hyderabad. he was appointed as a Minister of the Cabinet under the Military Government, holding the portfolios of Public Works and Railways.

During his professional career, Nawah Zain Yar Jung was responsible for the design and construction of a host of important structures. The most important of these are the Osmania University buildings, the Nizamia Mosque in London, the Madar-e-Deccan Mosque in Aligarh, the Anglo-Arabic College of the Delhi University, the Central Secretariat in Hyderabad, the Tuberculosis Sanatorium in Vikarabad, the Ibrahim Bagh Infantry Barracks, and the Osmania Technical College in Hyderabad. He was member of the Committee of Experts for the restoration and conservation of the Taj Mahal in 1942, and a member of the Committee for the restoration of the Badshahi Mosque, Lahore.

In 1943, as Chairman of the Hyderabad Centre of the Institution, Nawab Zain Yar Jung had initiated in Hyderabad a scheme of popular lectures on engineering subjects. The first public lecture on the design of Osmania University by Nawab lain Yar lung was inaugurated by the President of H.E.H. the Nizam's Executive Council. The series proved to be a great success.

Nawab Zain Yar Jung was not only responsible for securing from the Government of Hyderabad a suitable site for the construction of the building of the Hyderabad Centre but also had prepared the design for its construction. The foundation stone of the building was laid on November 25, 1945, by the Nawab of Chattari, the then President of H.E.H. the Nizam's Executive Council, and a special grant of Rs. 10,000 was donated by him. This beginning helped Nawab lain Yar lung to collect a very substantial contribution from the public, which resulted in the early blossoming of the building scheme of the Hyderabad Centre.

Nawab Zain Yar Jung as President of the Institution had the privilege of seeing in 1945 the inauguration of the Silver Jubilee of the Institution by H.E. Lord Wavell, Viceroy of India. Being then the Minister in charge of Public Works in Hyderabad, he had led from the State a delegation of 20 senior engineers, which, in turn, had the effect of accelerating the activities of the Hyderabad Centre. In 1946 when the Institution was urgently in need of stabilizing its finances, Nawab lain Yar lung was responsible in using his influence with the Government of India who donated a grant of Rs. I lakh. Similarly, he was responsible for obtaining for the Hyderabad Centre of the Institution a grant of Rs. 10,000 from the Military Government for completing the building of that Centre during 1949.

In 1951, Nawab lain Yar lung attended a joint conference of the three premier engineering Institutions of the U.K., the Institution of Civil Engineers, the Institution of Mechanical Engineers and the Institution of Electrical Engineers, as a delegate from this Institution. He was at the same time a leader of the Indian delegation to a Conference of the Standards Institutions of the

Commonwealth. On his return, he urged upon the Government of India the need for establishing an Indian Standards Institution, and it was as a result of his efforts that the Indian Standards Institution came into being.

In 1952, Nawab lain Yar lung Bahadur visited China as a delegate of the Indian Cultural Mission.

During his administration as Minister, Public Works, he was responsible for creating a separate department for irrigation in Hyderabad and also for establishing the Engineering Research Institute for researches in irrigation and general engineering practice.

He was a wise administrator zealous for the enhancement of the prestige of the engineering profession and a great friend of the labourer and the artisan. During his administration he raised the efficiency of the Department very considerably and was responsible for setting up of a high moral tone in the Public Works Department administration.

In 1955, Nawab Zain Yar Jung was commissioned by the Government of India to visit the Western countries in connection with the design of a National Theatre in New Delhi.

In 1956, he was awarded the Padma Bhushan for his distinguished services. In 1958. he was nominated by the Government of Andhra Pradesh to the Rajya Sabha. He retired from the Sabha in 1960.

He was also an eminent Rotarian and had the distinction of being elected a Rotary Governor.

The dedication of the remarkable book. 'Strongholds of India' (William Heinemann Ltd.) by the distinguished architect and author, Sydney Toy, F.S.A.. F.R.I.B.A, to him is a testimony to the architectural and engineering eminence of Nawab Zain Yar Jung.

Nawab Zain Yar Jung joined the Institution as Member in 1941. He was President of the Institution during 1945-46.

Mr E A Nadirshah

Esq., O.B.E., B.E., B.Sc. (Eng.), M. Inst, C.E., M.I.E. (India), F.I.S.E. (Lond.), J.P.

Chief Engineer, The Concrete Association of India

President 1946-47

Presidential Address

Gentlemen,

Introduction

I am indeed very grateful to the members of the Council of the Institution of Engineers for having conferred upon me the greatest honour that lies within their power, i.e., selecting me as the President of the Institution of Engineers for the year 1946-47, which I consider as the highest distinction an engineer can aspire to in his professional life. I am indeed conscious of the great responsibilities that this chair carries, particularly at a time when engineers have a tremendous and important task of giving help and advice in many and varied directions in building up an "Industrial India". In achieving this great task, I have not the least doubt that our great country will have the loyal support of the members of this Institution, individually as well as collectively. On my part, I shall make every effort and endeavour, not only to maintain the high traditions of this chair, but to promote the general welfare of the Institution and I shall spare no pains to justify the confidence reposed in me.

It is the usual practice for Presidents to address the members of the Institution on some special branch of engineering with which they are connected. I am going to deviate from this practice by addressing you on some important aspects of engineering which may help in building up our great country and may create an interest in as large a number of members as possible.

Pandit Jawaharlal Nehru on Necessities of Life.

Pandit Jawaharlal Nehru, in his presidential address to the Indian Science Congress in January this year, has very rightly pointed out that Science must think in terms of the 400,000,000 persons in India who need food, clothing, housing, education, health, etc.-all the absolute necessaries of life that every person is entitled to. He stresses on engineers, scientists and technicians the importance of solving the problems of the. New India by rapid planned development on all sides so that food could be made available. He has wisely pointed out that all the latent scientific talent in the country should be tapped so as to give it opportunities for growth and service to the community. This simple, but high ideal must have come to his Master Mind probably through an intimate knowledge the following main facts and figures for India:

Food Clothing and Income Statistics

(a) India is a deficit country for foodstuff, the food shortage being 41 billion calories. We should have about 6 million tons of food to feed at least our present population. In India an average person gets a diet which can hardly yield 1,200 calories per day as compared to the balanced diet figures of 2,600 calories per day, which according to Dr. Aykroyd should consist of :-

Cereals	... ...	15	ozs. per day
Pulses	... ...	3	"
Vegetables	... ...	10	"
Fats & Oils		2	"
Fruits		2	"
Milk		8	"

(b) the per capita consumption of cotton piece-goods in India is 15.5 yards as against 64, 34, 21.4 and 19.1 in U.S.A., Germany, Japan and Egypt respectively and

(c) the per capita income: of India is Rs. 70 but 90 per cent of India's population earn an income of Rs. 18 only per annum, as against Rs. 1,186, 1,013, 520, 176 and 133 for U.S.A., U.K., Germany, Japan and U.S.S.R respectively. Probably the following figures of India's income would make the position more clear:

1% of its population enjoy	35% of the total national income.
32%	33%
67%	32%

How can this most laudable object pointed out by Pandit Jawaharlal Nehru be achieved? Nobody can deny that it can only be fulfilled by proper, systematic and well-thought-out planning. Conditions in modern progressive life have become so complicated and international relations so interlocked that far-sighted, orderly and scientific planning is absolutely necessary.

Attempts at Planning

In India, Sir M. Visvesvaraya was the first to devote attention to this vital subject of Economic Planning. The National Plan-Attempts at ning Committee appointed by the Indian National Congress Planning has attempted to set up a blue print for the economic development of our country. The Government of India have set up various Post-war Reconstruction Committees to plan for India's future. Eight distinguished industrialists have presented a 15-year plan, known as the Bombay Plan, and have rendered a signal service. Then again, Mr. M. N. Roy has published a "Peoples" Plan" Which involves an expenditure of Rs. 15,000 crores in 10 years.

Principles and Main Objects of Planning

In fact planning should be so arranged and carried out that India's vast, undeveloped, latent and static energy is converted in stages to dynamic energy. If she has to stand competition against highly developed and advanced countries of the world, India's planning should achieve the following main objects, as a country's economical strength is always judged by its holdings of raw products, capacity to. turn them into finished products and the purchasing capacity of her imports against her surplus exports:

Development of Cottage Industries and Decentralisation.

(a) to secure well organized and powerful village communities with social security and economic culture by development of cottage industries, which in turn is bound to solve, to a very large extent, India's unemployment problem and improve labour conditions. It should not be lost sight of that 90 per cent of our people are employed on agriculture and the remaining in industries, of which 2 million souls (i.e., 0.5%) are working in large-scale industries. We have 700,000 villages scattered over an area of 1,808,679 sq. miles. More attention should therefore be paid to independent regional unit planning than to the concentration of all the industries in a few big cities. We should plan in a horizontal direction rather than vertical. Besides, decentralisation of industries will also be helpful against foreign aggression. In fact, American Architects have recently recommended not to have cities of more than 2 lacs population each so as to be safe from Atomic and other bombing;

Explanation of Man-Power and Natural Resources of the Country

(b) to establish a minimum standard of living for all with cultural and spiritual values of life by increased productivity and exploitation to the fullest extent of the country's man-power and its natural resources such as coal, oils, timber, cotton, water power and various minerals in order to promote welfare and full economic development of the country and happiness of the nation, so that every individual can earn his or her livelihood by just and honourable means. Peter the Great once said: "Bear in mind that the commerce of India is the commerce of the world and he who can exclusively command it is the Dictator of Europe";

Bringing more Area under Cultivation

(c) to aim at (i) the reclamation and cultivation of an area of about 170 million areas of "cultivable waste" by prevention of soil erosion, by providing proper drainage and resorting to terracing and (ii) the bringing of more area under irrigation by canals, tanks, wells, etc., as only about 23 per cent of the total area under cultivation (i.e., 55 million acres out of 244 million acres) is irrigated at present;

Credit Facilities

(d) to introduce measures to aid farmers by providing special credit facilities;

Development of Major Industries

(e) to develop major industries such as Shipping and shipbuilding manufacturing of Automobiles and Locomotives, Building of Aircrafts, Textiles, Hydro and Thermal electric power Mining and Metallurgy, Machinery and Machine tools, etc. If Australia, Canada and New Zealand, with but a fraction of India's resources in men, money and minerals can manufacture their own machinery, ships, air crafts, etc., in a short spell of a few years, why should not we succeed?

Development of Communications

(f) to improve transport and communications by Land, Air and Sea, by development of our road, rail, wireless, telegraphs, telephones, etc. and

Central Research Institute, Defence Forces, etc.

(g) in planning for attaining the above main objects the following points should not be lost sight of :-

1. Growing, handling and distribution of food,

2. Systematic destruction of pests,

3. Improving education, health, housing, sanitation, water-supply, etc.

4. Establishment of a Central Research Institute and

5. Development of Army, Navy and Air Forces for India's defence.

It will not be possible for me to deal with all the above subjects even superficially, and I shall therefore confine myself to the most important subjects of Education, Research and Communications.

Education—A Main Factor in Planning.

For Planning, the most important and vital factor is education which can very well be said to be its foundation. What we are to-day is what we were trained and educated to be in the past, and what our Institution is going to be in the next decade will be entirely dependent upon the type of education that our young men receive to-day. It is therefore essential that we, as an Institution, should take the liveliest interest in education firstly of the general type, i.e., pre-engineering and then engineering proper.

Improvement in the System of Education.

I cannot help feeling that our system of general education is far from satisfactory. Economic factors loom large on the horizon and there is also a lack of will on the part of those who could change the system for a better one. When people talk of mass education, they mean mostly the education of masses of students dumped together in a single class room, the class being conducted by an ill-paid teacher. Due to the low salaries which, in some instances, are even lower than those of sweepers in big towns, is it any wonder that mostly third raters have gravitated to the profession of teaching? They have no interest in their students except to get a little extra from the parents by giving private tuitions. With big classes there is a complete absence of personal touch.

India's Literacy Figure Low.

At present we can boast in India of having educated in arts, science, and technical subjects, about 15 per cent of its population of 400 million souls. Comparing this figure with the literacy figures of some other countries, it is apparent that India has a great headway to make. To achieve this object the policy of educating India's teeming millions should be laid down by the Central Advisory Board of Education, so as to have a uniformity all over the country.

Medium of Education

If India wants to keep pace with the progressing world, the first thing to decide is the adoption of a universal language as a medium of teaching. No doubt this is a very controversial subject and should be decided on the broadest principles; The world today has become very small as science has reduced distances. We have the prospect of travelling round the earth's equator in 24 hours (non-stop). Even a trip to the moon, a distance of 240,000 miles is a possibility now. In fact, this question should be decided by the U.N.O.

Basic Education

Basic education should consist of a full and compulsory education for every boy and girl in reading, writing, mathematics, sanitation of home and surroundings, health, social and physical training.

Secondary Education

Secondary education should be a self-sufficient unit and made so cheap as to be available to the masses in utility and vocational subjects. Museums, exhibitions, models, cinemas, cation. etc., should form the main plank of education. Examinations should not be the mere criterion of judging students but their general progress throughout the year should be the main consideration. Arts of painting, applied arts, crafts, etc. should be encouraged in early stages and all duplication of subjects avoided. Every school, every factory and every concern should have its own library of scientific and technical books, as cheap and abundant books form the most important line of attack against poverty and low standard of living. Physical and military training should form a compulsory subject. Every youth of India should be taught the principles of the defence of the country so that, when the need arises, India can immediately form a most efficient force required, for her defence.

Technical Education

Sorting out of technical and professional education should be done about 3 years before the Matriculation and School Leaving Examinations, during which period requisite facilities in such subjects should be given so as to form the bases of the development of a student who should devote his subsequent time and energy solely to the application of his own branch of studies till he takes a degree or diploma.

Facilities to impart technical and scientific education should be many times increased to meet the country's growing needs. The necessity of training of technicians in farming, engineering, chemistry, industries and building is so great that it cannot be overstressed. The two World Wars have proved this necessity beyond doubt and such training will eventually tend to the development of our mineral and power resources.

Curiosity to be encouraged.

There is one quality that we, as engineers, prize most. It is that quality by which the world progresses faster and faster on its onward march. It is responsible for all the inventions, the fruits of which we enjoy today. It determines, in spite of adverse circumstances, whether the country will be prosperous or otherwise. It is the quality by which we are judged on an intellectual plane by other countries and by which we shall succeed in standing shoulder with the most advanced nations in the world. I mean that great quality of "Curiosity". We should have no complaint whatever how an educational system runs, provided in the young men and women of the country this great quality of curiosity is inculcated and kept burning in schools and colleges. Is it ever possible with our crowded class rooms and ill-paid teachers to permit of an individual display of curiosity? When this state of affairs continues for years, the young student is intellectually killed before he sets his foot in the University. Then we ask the engineering colleges to resuscitate him in order that in the future he may take our place and do better-a truly herculean task. The mentality that prevails in schools has now seeped into engineering colleges as well and at least a few of them in the good name of post-war development have started the game of education amongst masses without an adequate staff, buildings or equipment-a proper mass-production factory, with this difference that a mass-produced article, with a powerful organization behind it is a perfect article, whereas, the student counterpart so produced is a half-backed student engineer.

Improvement in Technical Education.

In order that we, as a professional body, may playa most important role in the future, we demand that our technical education should be of the best type. Going through the engineering courses of the different universities, one is pained to find some glaring omissions. Of all the fellow professionals, the engineer comes in contact daily with masses of men, with different modes, manners, characteristics and types of thought; to deal with such a problem the modern engineer must become conversant with the great subject of psychology.

Psychology.

The human factor in all engineering works is far more important than the inanimate, viz., money and machinery. More schemes have been wrecked in the initial stages by one individual not pulling harmoniously with another than we care to admit. Laws of human behaviour are almost as immutable as the laws of science and they are amenable to study. A tremendous amount of work has to be done in the realm of industrial psychology, correlating work and environment, outlook and periods of rest, labour organizations and control, industrial accidents and their causes, and the most fruitful of them all, the measurement of intelligence and aptitude with the object of eliminating square pegs in round holes. It is my fervent hope that this omission from the engineering courses of this great subject of Psychology will be made good.

You will be interested to know that in a large number of American universities between 12 and 15 per cent of the time of an engineering course is spent in social humanities with the specific purpose of giving the engineer a broad background. Among the subjects included are English Literature, Economies, Psychology, History, etc. The modern Engineer has ceased to be a narrow technician and if he has to progress, he must sell his wares to the lay public. He must therefore be an all round man with a wide knowledge of the world and men of different professions and businesses around him. Our universities therefore ought to keep this important aspect of education in the forefront.

Electronics

There is another omission in the engineering course to which I should like to draw your attention. No matter whether one professes to be a civil engineer or mechanical or electrical, the impact of the new subject of Electronics is now being felt all round. Most of the measuring instruments now use electronic principles recording mechanical pressures, strains, steady or alternating, measuring vibrations in machinery, analysing acoustic properties, measuring pile driving strains, engine indicators and a host of other uses, too numerous to mention. It is absolutely essential that the engineering student is madefully conversant with this new subject, the most revolutionary use of which is the Radar and the Electron microscope.

Research in Engineering Colleges

There is still another aspect which our engineering colleges may consider with profit, not only to themselves but to the country as a whole. Far too long have the members of the staff played the part of middlemen in business, buying information from outside sources, usually foreign, and seiling it in the country. The time has now come when this one-way traffic must be made into a two-way one. They must intensively go in for research. Firstly it helps teaching. Secondly it introduces the students to the methods of research which, in the main, consist of finding facts, interpreting them and then using them for varied conditions on actual work. It is a great advantage for students to be associated with research as it brings into play some very useful qualities of resourcefulness, practical judgment, imagination, independent thinking, initiative and most important of all, capacity to bear failure with patience and equanimity as a spurt to continued effort. How fast the West is advancing in the matter of engineering training may be gathered from the fact that the California Institute of Technology has already a graduate course in "Jet Propulsion". It needs no prophet to prophesy that the next ten years will see the demise of the internal combustion engine that we see to-day. In this fast moving world if we are to play our part in keeping with the size of our country or population, we should waste not a moment to scan the bottomless depth of research. I shall revert shortly to this most important subject.

Education will obtain Freedom

In fact, the whole education system should be so devised that it can give every citizen Freedom of speech or expression, Freedom of religion, Freedom from want and Freedom from fear (the 4 principles of the Atlantic Charter) and we as Engineers should be prepared to dedicate our children to Science and Engineering without any distinction of race or creed.

Education-the Basic Industry of the Country

We note with great satisfaction that in his recent speech at the Institution of Engineers' meeting in Bombay, Mr. Kher, the Prime Minister, promised that the present system of education would be overhauled so as to provide more practical training. It is also very gratifying to note from the recent presidential address of the Hon. Mr. C. Rajagopalachari, the then Member for Education, Government of India, at the 13th Session of the Central Advisory Board of Education that the Central Government have planned in general terms to spend on education between the provinces and the centre about Rs. 125 crores during the next 5 years. He has rightly stated that Education is the basic industry of the country. Industries depend upon the quality of men we give them and the quality of men depends upon the education that we give them. His Excellency the Governor of Bombay, Sir John Colville, laid stress at the same session that education was the very foundation of the National development in all directions and that technical subjects, which had not hitherto received due attention in this country, should take their rightful place. It is true the Central Advisory Board during its life of 12 years has put up and published various reports, the latest one being Sargent's Report. We engineers, however, as men of practical commonsense only hope that we will soon emerge from this stage of report-making to the constructive stage of action.

Research.

Let us now go to the next important factor which would help in planning, building and maintaining an Industrial India, namely Research. First let us see how our country stands in comparison with other countries in the field of research. The best idea could be obtained from the facts and figures given in the following table which has been reproduced for ready reference from Principal Taraporevala's paper in the Silver Jubilee volume of the Institution of Engineers (Bombay Centre), from which it will be seen that India has spent in 1937 only 0.3 crores of rupees as compared to Rs. 9 to 150 crores spent in Great Britain, U.S.A. and Russia, whereas per capita expenditure in rupees varies from 2 to 9 in these countries as against 0.0013 for India:

Country	Year	Annual expenditure on research in crores.	Per capita expenditure in rupees	Percentage of estimated National Income.
Russia ..	1934	90-150	5.4-9	2.4-3
United States ..	1935	90	7.2	1.5-1.8
Great Britain ..	1934	9	2.1	0.45
Canada ..	1938	0.72-1.0	0.66-0.87	0.18-0.24
India ..	1937	0.3	0.0013	0.015

Destruction and Creation

Research destroys and creates. It can destroy a big business in a short time. In the year 1850 there over 2,500 miles of canals in U.S.A. representing an investment of 2,100 crores. In 1860 Railways began to come into existence and by 1870 they practically killed the system of canal transportation. Similarly in 1910 automobiles came into existence and in 1940 railways lost 15,000 miles of their track, the investors losing about 3,000 crores. Now it seems to be the turn of the cotton industry as it will have soon to face great competition from synthetic fibres like Rayon, Nylon, etc. The atomic bomb that was dropped on Hiroshima killed about 80,000 persons. Professor Marcus Oliphant, atomic bomb expert and Professor of Physics stated during a public lecture that scientists had produced an atomic bomb six hundred times deadlier than those that were dropped on Japan, which implies that it can kill 48,000,000. Wire transmitted telegrams may soon become a thing of the past when messages will be transmitted by light waves (telefax). Its creative power is also very great, for example Edison's discoveries in the field of electricity brought more wealth to U.S.A. than the gold mines of California or Nebraska. A majority of business firms have been founded in America to commercialise inventions made by research and they remain in business on account of research. As a result of research carried out by Russian laboratories on tobacco fermentation, a saving of about $2^1/_2$crores of rupees has been made in the State tobacco industries after spending a very small fraction of this amount. The Electron Microscope has now taken the field. An optical microscope whose magnifying capacity is limited by the wave length of the light enlarges up to 2,000 times normal. This new invention has already attained the magnification up to 200,000 times normal and it has the possibility of attaining a magnification up to 200,000,000 times normal. It is bound to play a very important role in the advancement of Medical and Engineering Sciences. Atomic bomb was produced at a cost of rupees 600 crores as a result of organised research. Imagine, on account of atomic energy, the great limitation in the weight of fuel to be carried, as a pound of atomic energy is equivalent to 180,000 tons of T.N.T. or 10,000,000 lbs. of petrol and a pound of uranium 235 is equivalent in heat energy to 20,000,000 lbs. of coal. Well, if energy can be cheap for all mankind, every individual will get his or her comforts and there can be nothing else but peace and harmony amongst men and nations. It has been estimated that in Great Britain after spending rupees 67 lakhs per year on industrial research a saving of not less than 6.5 crores per annum has been effected in industrial concerns.

Establishment of a National Research Institute.

We in India should have a National Research Institute which should co-ordinate the efforts and the results of other research institutions existing or to be founded in different provinces and States, conducted by various Government Departments, Universities, Colleges and Industrial concerns. All these bodies should have large and well equipped laboratories with facilities for full scale research.

Scholarships.

Financial barriers to higher research education should be removed by providing scholarships so that talented individuals in every State or province could come forward to give the benefit of their latent intelligence in the nation building programme. Last year, I.C. (England) announced an award of 80 research fellowships of £600 each per year in Physics, Chemistry and allied subjects tenable for 5 to 7 years at 9 English universities. The Research Institute I.C., I am told, consists of 900 fully qualified scientists and engineers and more than 1,000 skilled assistants and in 1943 alone they spent as much as £2,200,000 on research. Sir Homi Mody, in his speech at the 10th annual general meeting of the Associated Cement Companies, Limited, stated that a well-equipped and adequately staffed Central Research Laboratory was now being planned and the work of designing and laying it out had been entrusted to a well-known firm of architects. The laboratory is estimated to cost about rupees 20 lakhs. These are indeed good examples for our industrialists and capitalists to follow. and they should establish their own separate organisations for research which should work under the control and direction of the Central National Institute.

Scope and Function of the Central Research Institute.

As suggested by Principal Taraporevala in his paper on Organization of Research in Engineering, the Central Research Institute (under Government control) should be planned on a very comprehensive basis so as to undertake various kinds of tests for all Government departments, Local bodies, private industries, etc. Its scope and functions should be:-

(a) to supply routine information on the quality of materials;

(b) to develop further information on known materials or to develop new materials;

(c) to obtain accurate information regarding fundamental properties of materials, and

(d) to draw up independently or to assist in drawing up in collaboration with other departments and public bodies, specifications for materials, codes of practice, codes of safety, etc.

Different Departments of the Central Research Institute.

To achieve the above objects, the Central Institute should have the following special laboratories on the lines of the Department of Scientific and Industrial Research in Great Britain.

1. Physical Laboratories with different branches for
(a) Physics,
(b) Electricity,
© Radio,
(d) Meteorology,
(e) Engineering,
(f) Metallurgy,
(g) Aerodynamics,
(h) Hydro-dynamics, etc.
2. Building Research.
3. Road Research:
4. Chemical Research.
5. Food Investigation.
6. Forest Products Research.
7. Fuel Research.
8. Water Pollution Research.
9. Geological Survey and Museum.
10. Miscellaneous.

Engineering and Physics Sections

The Engineering and Physics Sections under 1(e) and 1(a) should have all facilities to carry out experiments and investigations on (i) fatigue in metals and other materials under combined bending and torsion; (ii) effect of high temperature on creep of metals; (iii) mechanical properties of spring-steel, fatigue and failure of springs, causes of failure of W.I. chains and other lifting tackles, etc.; (iv) pressure of wind on structures like buildings, bridges, etc.; (v) heat transmission from surfaces to fluids flowing over them; (vi) detonation or explosion of gaseous mixtures; (vii) investigations of the motion of stream-line forms in an air current of high velocity; (viii) flow of oils and other liquids in pipes; (ix) testing of large structures, floors, columns, engines, etc. and gear investigations; (x) the study of lubrication and height of cylinders used for storage and transport of compressed gases; (xi) vibrations of buildings; (xii) application of electric welding to steel structures; (xiii) Wear of metals, corrosion fatigue, etc.

The Road Research laboratory should be busy on (a) planning and design, (b) soil and stone for aggregates, (c) cement and other road materials, (d) bituminous construction, (e) miscellaneous road elements and structures, (f) surface characteristics, (g) movement control, (h) vehicle characteristics, (i) the effect of wheel size on impact and skidding of vehicles on road, (j) constructional plant, machinery and equipment, (k) road safety, (l) information, (m) soil mechanics, (n) soil survey and its application to road construction.

Usefulness of Testing Sections

The testing sections of the Central Institute and its branches should be able to do the testing of all kinds of materials (finished and/or raw) and also of the finished products such as machine tools, etc. Such tests are bound to render a very useful service to the various manufacturing concerns, public bodies and industries. It will enable all concerned to produce goods on a competitive basis by cutting down manufacturing costs and the cost of raw materials and to introduce refinements in their design.

Research Library

A central library should form a very important branch of the National Research Institute where collection of world literature should be made. Journals from all over the world should be subscribed to, scrutinized, indexed and abstracted for the use of all research workers If funds permit, branches of this Central Library should be established at all important research stations in the country.

Research Propaganda

Interesting facts of science and results of research should always become front page news instead of strikes, lockouts and other propaganda news. Figures of industrial production, should be frequently published to impress the public that their standard of life is so very dependent on industrial production.

Finance.

As regards financing such a scheme, it will be admitted that it will be a good investment for industrialists to contribute towards the building up and maintenance of such an Institute as I am sure such investments would yield them in course of time ample and handsome dividends in form of increased profits in their business. If such co-operation is not forthcoming, then the Government would be well advised to force upon the industrial concerns by legislation to subscribe contribution on certain percentage basis.

Communications

Now we cannot make any appreciable progress or take the full advantage of planning by education and research or industrialise India unless we have an adequate system of communications in the country. Throughout my career as an Engineer (for the past 25 years) the most outstanding drawback of this country, which has pressed upon me and which I consider restricts the progress of the country in many fields, including the food problem. is the lack of adequate communications. We cannot expect to have any scope for the advancement of the engineering science or enjoy civic amenities, social happiness and industrial prosperity unless we all, particularly engineers, concentrate on "Means of Communications" which are a pre-requisite to an improved standard of living of the inhabitants of the 700,000 villages in India.

Improved Standrard of Loving

Take for example, electrification and the development of power resources. By developing cheap electric power, a considerable stimulus can be given to many small industries on the countryside, but to be able to supply cheap power there must be a demand for electricity sufficient for the electric mains to work on economical lines. In big cities, the large volume of electric power consumed for lighting purposes enables power to be supplied for Industry at very cheap rates. It is the same principle as in all mass-production schemes. Just as an article coming out of a gigantic factory costs in mass-production a mere fraction of what it costs to design and produce its first sample, so also when production and consumption are on a mass scale the cost per unit is progressively low. The supply of cheap electricity for industrial expansion in mofussil centres will become possible if the demand for electric consumption for lighting purposes is adequate in the area. But how many of our 700,000 villages can afford to enjoy the benefits of electricity for lighting even if this facility is given to them? It is here that the poor standard of living hampers the engineer. With an average annual per capita income of about 70 rupees, in how many of our villages can there be a demand for electric lighting? Take some of the other countries for comparison. The United Kingdom has a per capita income over 14 times higher and the United States about 17 times more. If this low standard of living in India is to be remedied, means of communications must be improved. If there is one instrument more than another that can create wealth in our poor land with all its rich resources, it is the provision of an adequate communication system. It is fundamental to all movement. America today owes its advancement over other countries in the world to its efficient system of communications. Today U.S.A. and U.K. have one vehicle per 4.2 and 15.6 population. India cannot boast of more than one vehicle per 2,000.

Road Communication more Vital to India's Growth.

Communications can be improved by land, air and sea. India is such a vast country that it needs the development of all these 3 forms of communications, as each has a distinct role to play in the industrialisation of the country, thus promoting and maintaining peace and happiness amongst its teaming millions. The result of the findings of the various committees and commissions and the important speeches made by some of our greatest political leaders lead one to think that of all the communications, roads need the country's immediate and most serious attention as they do and will play a very important role in securing and then maintaining the independence of the country. Amongst all communications, roads no doubt have occupied the pride of place in any country. Even those parts of the country which are served by railways, airways and waterways are dependent on roads to feed them. In fact, without roads, the other forms of transport cannot function effectively and the railways in particular have been handicapped in the past through a lack of feeder roads.

Public Demand for More Roads

During the past few months leading newspapers have evinced a great deal of interest in the urgent need for road development in India, reflecting the general consciousness of the public of the poverty of the country in the matter of roads and the impossibility of securing an advance in the country's prosperity until more roads are constructed. There might be a difference of opinion as to what class of roads should be constructed but none at all for creating an efficient system of roads in this country.

Politicians, Governments, etc. Stress the Importance of Roads.

Many authorities could be cited to show how a lack of roads is impeding the progress of the country. The National Planning Committee, of which Pandit Jawaharlal Nehru was the President said in 1940. "One of the most considerable handicaps of the existing economy in India is the lack of cheap and adequate transport service in rural areas, which it is considered, is likely to be provided by a better development and use of the roads as between villages and as also those connecting the villages with markets."

His Excellency the Viceroy has spoken of the importance of transport facilities in the following memorable words: "I put Communications first (in the development of social services) since I do not see how it is possible to effect any great improvement in health or education in the villages of India until they can be reached surely and quickly at all times.

The importance of adequate transport facilities was very well emphasised by the Bombay Economic and Industrial Survey Committee under the Presidentship of Sir Purshotamdas Thakurdas in 1940. The report of the Committee pointed out that from the point of view of the building up of markets and industrial mobility in general, different centres of production and consumption should be connected with reasonable transport facilities; and in Bombay since between 40 and 75 per cent of the total area in many districts was not served by roads at all and still greater areas were totally cut off during the monsoon, this meagreness of communications contributed to the backwardness of the province in the realm of industrial development. The Committee went on to say that the injurious effects of inadequate transport facilities could find no better illustration than the district of North Canara which, in spite of vast resources of raw materials and power, remained a backward area with a declining population, Assuming that in order to quicken the pace of industrialisation, no less than to ensure better prices for the cultivator, one of the first essentials was the improvement and extension of transport facilities, the Committee recommended a programme of rapid road construction for which they held that the use of loan funds was perfectly justified.

Nor are records wanting to show the prosperity resulting from road development. For example, in the Settlement Report of Mr. E. H. N. Gill, I.C.S., of Tahsil Dehra in the district of Dehra Dun (1941), it is stated: "Not only bas it (the improvement in communications) assisted the colonisation of large tracts. in the eastern pargana, facilitated the import of food grains, stimulated the export of rice, lime and timber, encouraged the agricultural industry generally, brought prosperity to Dehra itself, but it has brought vividly before the public possibilities of the Dun both as a beauty spot and health resort."

Many of you are perhaps aware that at the suggestion of the Government of India, the Indian Roads and Transport Development Association carried out in 1943 a Pilot Road Survey of certain parts of Bombay Presidency to evaluate the economic benefits conferred by an adequate road system in comparison with the cost of such roads to the Exchequer. The Association found that the main sources of financial profit to the community from roads could be placed under 3 heads, firstly, savings in transport costs, secondly, increase in land under food crops and thirdly, extension of money crops and industries including fruits, vegetables and other truck crops, the dairy industry and irrigated fodder production. The conclusion arrived at by the Survey was that for each sum of rupees 100 spent annually on construction and maintenance of roads, the return, through increased earnings to the community, would amount to rupees 277 without taking into account the inevitable rise in the revenues to Government and the additional traffic that would be created for the Railways.

Roads necessary for the bare amenities of civilisation, particularly for agriculture (food).

One of the worst defects in India's economy today is that her roads have not, either in quantity or quality, kept pace with developments in other spheres, such as the increase in population, agriculture, industry or commerce. India today has not the means of communication that she should have in order to confer the barest amenities of civilisation, whether in the cultural, hygienic, social or economic sphere. In a predominantly agricultural country like India, the scarcity of food, of which we hear so much today, would not have been such a bugbear, had the country been adequately provided with rural roads. One of the chief reasons why vast areas in the country are lying fallow is that owing to the lack of roads and the consequent lack of access to these areas by the villagers and also from then on to the markets, the cultivation of such lands has never been a paying proposition. The economic loss resulting from the inadequacy of roads is tremendous. It is most important that if agriculture, which is India's major (30 per cent industry, is to contribute effectively to the supply of our primary needs, the interests and convenience of the agriculturist must be specially borne in mind in planning for the new India. With better and more roads, which mean cheaper transport not only millions of acres of untilled land in this country could be brought under the plough, but even the cultivated areas could be made to yield richer harvests, with the certainty of economical marketing and cheaper production. Likewise the perishable products whether in the form of fruits, vegetables, eggs, poultry or dairy farming need not go to waste for want of quick transport, but could be despatched fresh from centres of production in the villages to their nearest markets, creating wealth for the villagers and promoting the health of the country through better nourishment.

Fertilizing and enriching the soil

Even those areas which are at present under cultivation yield lesser and poorer crops every succeeding year due to the soil not getting enough or any nourishment to recoup its productivity. Increasing the food production capacity of the country is the most important problem to be tackled and if India has to grow more food for its increasing population, the top soil should be enriched; but how can this be done without an adequate means of communication with the vast areas of land at present out of reach of fertilizers and scientific means of enriching the soil ?

Strain on cattle wealth

Besides, it is hardly realised what extensive damage is being caused to the country's already depleted cattle wealth due to the excessive strain imposed on bullocks whose length of life wealth and usefulness are substantially reduced on account of bad roads and katcha tracks.

Roads for the development o f industries.

Next to agriculture, the most important factor to increase the standard of living is the development of industries and here again, roads are all-important. The location of factories and the extension of markets for new products are necessarily governed by transport facilities. It is also well-known how the cost of transport enters into the manufacture and distribution of every article; thus without good roads, neither can raw materials reach the factories cheaply nor can the finished products reach the consumer at economical prices.

Removal of all social and economic barriers.

Unless all the villages are linked with main highways (existing or to be constructed) at least we engineers cannot possibly visualise how the rural areas can be developed and hungry and famishing areas fed. Roads no doubt will then break up all social and economic barriers and simultaneously with growth of education and knowledge will give fullness of life to all.

India's road mileage al compared to other countries.

To compare India's road mileage with that of other countries in relation to the area or population is a lesson in itself. For an area of 1,808,679 sq. miles, India has about 270,000 miles of roads (including surfaced roads—9,650, water bound macadam roads—76,142, gravel and murrum roads 29,473, natural soil and fair weather roads 1,22,736 and cart tracks-32,000) which works out to a road mileage of 0.17 per square mile of the country. Taking other countries on the same basis the figures are 1.03, 18.84 and 2.02 miles per square mile in U.S.A., France and Great Britain respectively. So India's road mileage must be increased from six to twelve times at least to bring it on a par with that of the other countries mentioned.

Proposed road plan will not meet country's needs.

It is true that in the present plans for reconstruction, road development does find a place. A programme designed to extend the road mileage of the country to roughly 400,000 miles in the next 15 years at a cost of about rupees 450 crores is the provisional plan, but it will be obvious that this programme does no more than touch the fringe of our road problem. Over such a long period as 15 years, our aim should have been at least to double the road mileage so that at the end of the period our road system, in relation to area, might be at least one-sixth of what Great Britain now has. As so aptly pointed out by Mr. Kynnersley, the President of the Indian Roads and Transport Development Association, and a former President of our Institution, the-present programme will just provide one mile of new road in 15 years for an area of 18 square miles! Or if viewed in relation to our 700,000 villages, the programme on an average amounts to one mile of new road in 15 years for a group of half a dozen villages.

Village roads first

As we Engineers see it, all programmes that are contemplated in our reconstruction plans, not only for social services, but also for economic progress, depend for their success on road development. So it is to be fervently hoped that the present target of the Government in regard to road development will be substantially increased and everything possible done to accelerate the commencement and execution of the works, but the plan must begin with the development of village roads.

Road programme for Hyderabad state

Hyderabad State should be congratulated for already making a good start on the schemes for the expension of her highways, major and minor district roads and village roads to open up the country with a view to agricultural, industrial and commercial development. The new plan aims at the laying of one mile of road to every 3.38 square miles of the territory as against the present figure of one mile to every 15.39 square miles. In the next 5 years about 5,500 miles of roads will be completed.

Looking ahead

We, as engineers, cannot indeed fail to recognise roads as an engineering problem. We want to design them not merely for today's conditions but for the changes that may come about during the next 20 or 30 years. The American interregional highways are being so constructed as to be suitable for traffic of a volume, speed and weight, estimated to exist 30 years hence. Even a development of a limited access or freeway system is under contemplation. Future road building must necessarily be marked by new engineering and construction, and new. engineering concepts, based on the practices in more advanced countries, will cause a re-orientation of road construction methods, making pre-war methods obsolete in many directions. Industrial decentralisation, reduced working hours and increasing population mean growth of traffic and higher speeds demanding increased road capacity with longer sight distances, decreased gradients and flattened curves. Safety needs call for a separation of opposing traffic and the elimination grade crossing and intersection hazards.

Ribbon development and its evils

One chief defect of many of our main roads is that their traffic value has been impaired by buildings which have sprung along their course. This evil known as "Ribbon Development" not only impedes traffic flow by reducing the width of roads available for through traffic but it also constitutes a grave danger to road safety.

When a road is built, the land-holders along the road are enabled to sell their lands at increased rates for the construction of shops and residential quarters. Such development in due course makes it necessary for the roads to be widened and by then the value of the roadside lands will have increased to such an extent — because compensation will naturally be demanded by the owners for abandoning their built-up premises — that widening of the roads cannot be attempted except at a prohibitive cost. The general procedure then is to construct a by-pass road, but gradually the object is defeated by buildings again springing up along the by-pass itself.

Legislation necessary on a uniform basis.

Legislation, as you know, has been in force in England for the last 11 years restricting such building operations within 220 ft. of the middle of main roads. The same principle is adopted in the U.S.A. through their Highway Zoning Acts. More recently the U.S.A. has built hundreds of miles of special motor roads, freeways and limited access roads on which local traffic is reduced to the minimum. England also is contemplating the construction of similar roads.

In India what is most important at the present time is the prevention of the conditions which later on may be incapable of remedy except by special motor roads. I believe Delhi Province is the only area in India where legislation to this end has been adopted. By the "Delhi Restriction of Uses of Land Act 1941" the Chief Commissioner of Delhi has the power, with the previous sanction of the Central Government, to declare any land within a distance of 2 furlongs from the central line of any metalled road, to be controlled area in which erection of buildings and laying out of access roads cannot be undertaken without the permission of the Authorities. Two other provinces, viz., Bombay and the Punjab, have had the matter under consideration for some time and although legislation was drafted some months ago they do not appear to have passed it yet. In Bombay the draft Bill which is known as the "Ribbon Development Prevention Bill" applies to roads of every class and seeks to lay down varying limits of controlled space according to the importance of the roads, differentiating also between municipal and non-municipal areas. The controlled space along a National Highway outside municipal or village panchayat limits is proposed to be 200 feet from the centre line of the road, this being the highest limit provided for. The minimum controlled Space is along a village road within municipal of panchayat limits, the distance controlled here being 25 feet from the centre of the road. As regards the Punjab, the proposal is contained in the Punjab Highways Bill and the intention is to restrict buildings within 220 feet of the middle of Provincial Highways.

The Bombay Bill seems to be on right lines and it is in my opinion imperative that all Provinces and States should pass legislation of a similar nature. The evil of Ribbon Development is spreading day by day and the need for speedy action cannot be over-emphasised.

Road users should demand full value of taxes they pay.

Although with intelligent planning and efficient execution, roads always pay as they are made, yet whenever there is a question of reducing the expenditure or finding more money to meet some other obligation, road expenditure is reduced and/or road funds are raised. Even with existing depleted and unsatisfactory road system, a total revenue of rupees 960 lakhs was derived from road users in 1938-39 whereas only about rupees 602 lakhs were spent on roads, which shows that over 37 per cent of the revenue derived from road users may have been diverted to some other works. The road users contribute as much as 12 annas to a gallon towards excise duty besides the sales tax which varies from 1 anna to 5 annas per gallon in different provinces. In return what do we get — Bumps? It is not understood why the road users are so tolerant. Why can they not make a legitimate demand, for the full value of the taxes they pay in one form or another, in the form of more roads and better roads? Could not we engineers — one and all — protest against the appropriation of road funds to some other objects? Could we not use our influence and do our best against this sort of step-motherly treatment towards roads? I am sure enough spade work on the importance of the development of the road system of India has been done and reams and reams of blue prints for road development have been prepared. Now is the time for the execution of these plans. The work should now be left in the hands of engineers. Give them the money they want and the job will be done.

The role of Engineers

Engineers and scientists along with technicians being the main pillars of industries, and having the vision to create, have played and will always playa great part in War and in Peace, in planning and execution of schemes, in paving the way of reconstruction, and in starting a New Order of Society, in which people can live in peace and harmony. It was the engineers who produced the Mulberry Invasion Prefabricated Harbour for landing the troops in France, but for which the 2nd World War could not have been won by the Allies. Just as the well-being of the world depends upon the work of engineers, so also the well-being of India will depend upon the work, imagination, scientific knowledge, vision and keenness of our Indian engineers. We have unlimited opportunities through the field of engineering of doing useful and practical work. Our Institution which is national in character and represents all branches of Engineering (civil, mechanical and electrical) and which is an active leader of the Engineering profession can certainly create through its members a good atmosphere, but it has always been our grievance in India that our expert knowledge and advice are not utilised to the fullest extent by the State or Political leaders who really aim at the welfare of the masses. Popular Ministries throughout the country have embarked or are embarking on wide and far-reaching construction plans (I do not use the term reconstruction) involving crores and crores of public money. Never was there a greater opportunity than at present of a closer co-operation between engineers, scientists and technicians on the one hand and the Provincial and Central Governments on the other. The latter should utilise the expert advice and services of the former in the framing, planning and execution of policies and schemes. They should take the engineers and scientists into their confidence and treat them as their partners (and not as their servants) in the construction, development and industrialisation of India and in bringing back and preserving the glory of our country. Government, public bodies, educational institutions and industrial concerns should find it to their advantage to look to this Institution and utilise the experience and technical abilities of the large number of our engineers in their existing undertakings and future planning and schemes. We on our part should now try to solve our engineering problems by devoting ourselves more to practical engineering, i.e., the administration of economics of engineering projects. We should try to use more commonsense than solving our problems on a mathematical basis. We should seek more openings in the administrative branches of the civil and other services, or enter into partnership with capitalists for starting new industries for the development of the country. We should not remain any more silent spectators, whose works only speak and they themselves go as a hidden treasure, unrewarded and unappreciated. We should try to be more vocal, take interest in the problems of planning, economy, industry, research and education of the country. We should always speak with one voice (and that is through the Institution) in all important matters.

Compilation of useful information by the Institution.

The period which lies immediately ahead will be full of various engineering and industrial activities, such as road construction, irrigation, water-supply and sanitary projects, electrical and industrial schemes, agricultural development, research, etc. The Institution, through its various committees, should take up the work of compiling all sorts of information regarding data, design, cost, constructional difficulties, peculiar features, etc. of the various projects and schemes after completion under suitable headings. Such compilations, which could be kept up-todate from time to time, besides diffusing knowledge, would serve as a very useful source of information and guidance to engineers when they prepare new schemes in their respective provinces and States so that the same mistakes may not be repeated and full advantage may be taken of previous experience of other engineers.

Improving Service Conditions of Engineers.

Though we are an all-India body, we have not so far attempted in a practical way, to fix a certain uniform basic scale of pay for engineers according to their experience. Every province, and practically all local bodies and industrial concerns have adopted their own standard of scale. No doubt service conditions do vary in different parts of India but such variations could be compensated for by special allowances according to the index of living, etc. Besides there are no fixed hours of work; sometimes engineers have to put in over 12 hours of work every day, and day after day, without any compensation. Continuous working for long hours, gives no opportunity for healthy growth of a person in mind or in body. He gets no time for reading and thus keeping himself up-to-date, and eventually he turns himself into a machine, i.e., a mechanical worker. The Institution will be doing indeed a very useful work if suitable steps are taken in this direction.

Rai N K Mitra Bahadur

O.B.E., B.Sc. (Engg.) (Glas), M.I.E. (India)
Chief Engineer, E. I. Rly. (Retd.)
President 1947-48

Presidential Address

Your Excellency, Ladies and Gentlemen,

My first duty is to thank most sincerely the members of Council of the Institution for electing me their President for the ensuing year, the highest honour that lies within their power to confer on any Indian Engineer and one which I value higher than any other. At the same time when I think of the eminent and distinguished men who have occupied this position in the past, and of the present momentous period of our history when foundation for our future material advancement and therefrom our future status among the nations of the world, will have to be laid, I cannot but feel that a great load of responsibility has been placed in my not too broad shoulders. I would therefore most humbly ask for your close co-operation and active help in the discharge of my duties and on my part I pledge myself to serve the interests of the Institution to the best of my ability.

Gentlemen, — This is the first occasion we meet in Free India. The way this freedom was attained should be an inspiration to all of us and we Indians particularly, should feel proud that in a mechanical and atomic age, the Father of our nation, our own "half-naked fakir"— peace be to his soul — discovered the weapon of non-violence which has won our freedom. It is almost paradoxical that one of the mightiest powers in the world, who always believed in meeting violence with violence and who had just successfully emerged from a grim and desperate fight with the aid of the most destructive weapons which science and technology could devise, should succumb to this weapon of soul force and surrender a mighty empire. And what is the result? As expounded by the inventor of this weapon, the bitterness, hatred, malice and the ill-will against the rulers disappeared like magic almost overnight. It is unbelievable that the people who for the best part of their lives had suffered terribly at the hands of the British rulers in India and who have with equal determination fought them for long years against heavy odds, should voluntarily select one of the ruling race to be the head of their own independent Government. I believe it is only the British who could have dared to venture into an unexplored field like this and it is only the Indian who could react in this fashion. May we hope that other nations of the world will see in this method something which could hereafter settle international disputes and differences without bringing human beings to the level of beasts and causing immense suffering to all and possible destruction of human civilisation.

It is however a matter of great sorrow and shame to us, Indians that even when the victory of non-violence is being established, some of our own peoples forgetting our past history, culture and moral and spiritual ideals should make an exhibition of violence, brutality and bestiality unknown to our land and culminating in the brutal assault and murder of the great Apostle of peace and soul force. But who has ever known a birth taking place or an operation performed without some attendant pain. And let us hope that out of the supreme sacrifice of the greatest man of our age, his own people will fully realise the import of his ideals and teachings and end all hatred, all suspicions and all fractricidal inclinations and get together to maintain our freedom.

Our Freedom must be Utilised for Removal of our Poverty and this can only be done by Hard Work and Exploitation of Natural Resources:

But what is our independence worth if our people most of whom do not know what a full meal is, continue to live in utter misery and suffer from hunger, disease and ignorance. This freedom means that we, as a people have now acquired the right to do things in our own way, so that henceforward the responsibility for making or marring our national life and economy will rest entirely on ourselves and we shall rise or fall again according as we mould and shape our affairs and as we behave and work. Mere wishful thinking and philosophical analysis of our ancient culture and history and our past contributions to the metaphysical and spiritual spheres will lead us no where. The fact has to be faced that our people are extremely poor, and that to remove this poverty we must all work, work harder than ever, not only with our brains and hands but also to a greater extent with the help of natural power. As Professor Dr. S. K Mitra pointed out sometime back.

"The average man of a wealthy country is better fed, better clothed, better housed and enjoys amenities of life more than the average individual of a poor country. But who works for him to supply him with the articles of his needs and comforts? He cannot himself do all the work necessary for all these. The capacity of man as a machine for doing work is very limited. He must employ somebody else to work for him. These 'somebodies' in ancient times were not infrequently slaves captured from conquered countries. Man also tamed animals and made them to do work for him. In modern times slaves are not available, and animal power is insufficient to do all the work that is needed. Man, therefore, employs natural power for the purpose. To understand more fully the implication of this, let me quote some figures in respect of Great Britain. The total output of work per capita in Great Britain per year is roughly equivalent to that which may be done by 1,800 units of electric energy kilowatt-hour). Of this work only 5 per cent is done by man and animal power and the rest by natural power-gas, electricity, steam and water power. Now, each unit of electric energy represents roughly the work of two men per day. We may, therefore, say that every inhabitant of Great Britain has, as it were, 7 to 8 mechanical slaves working for him. What do these slaves do? They produce for their master commodities either for his own use or for exchange with commodities from abroad and also help in their distribution. Now imagine for a moment that these mechanical slaves for some reason struck work and the inhabitants of Great Britain are compelled to do all the work themselves by manual labour. The output of work will at once fall down to one-twentieth of its original value and the out turn of commodities also in the same proportion. Now take the case of India. Compared with Great Britain's figure of 1,800 units India's is only 120 units, and of this 70 per cent is done by man and animal power and only 30 per cent by natural power. India has only one mechanical salve for every 6 persons, instead of 7 or 8 for each person.

In order therefore that we may remove poverty and get comforts and amenities of life we must work, and harness natural power resources and utilise the same in industries of all types and produce all the necessaries of life, food, cloth, consumer goods, medicines, and thousand other items of our needs.

Russia's Transformation in 20 Years.

Tsarist Russia was like India a poor agrarian country with backward industry and three quarters of the population illiterate. Soviet Russia in 20 years' time has changed her into a rich. industrial country of high production and is now a Power to be reckoned with. But what was the secret of her quick transformation? Sound Economic planning and firm determination and forced development of natural resources by stages and hard work by all. The rule there, is, that one must work or else he being a drag on the nation will be liquidated. Even on 31st December, 1947, Moscow Radio reported that on that day "several railway officials in Russia had been imprisoned for delaying the turn-round of railway wagons".

Engineers' Task in Removal of Poverty:

If therefore removal of our poverty is our goal and if this can be done mainly by planned utilisation of natural power and resources of the country, the part that Engineers and Technicians and Scientists can play in this regeneration is obvious and on them rests a heavy responsibility. They are the people who will have to plan, design and construct and their quality and capacity and the extent of support and co-operation they get from the Government and the people will determine when their task will be fulfilled.

Our Valuable Assets:

In many ways we are in a fortunate position. Our Government is headed by brave men of vision, energy and determination, men who have for years voluntarily gone through a great deal of suffering for the attainment of their one ideal, viz., to get the self-respect of their people restored, men whose sincerity and honesty of purpose and action are unquestionable. We have a vast population, the great majority of whom are intelligent and have a cultural background and who can readily take on new ideas and if trained can, in a short time, produce things to any pattern supplied. From our lofty mountains flow many rivers right across all parts of the country, capable of producing incalculable amount of power. Our mineral and material resources are great both in quantity and in variety. With all these precious gifts from the Almighty, it should not be very difficult for us to make quick progress in all spheres of our life provided we have internal peace and go about our business in an organised, methodical and scientific manner and with confidence in ourselves and with determination to succeed.

The Four Pillars on which the Edifice of India has to be Built.

We have got to have faith in our own moral and spiritual ideals and culture, but at the same time, imbibe and absorb from the British their character and doggedness, from the American, their technical skill and organisation and from the Russian their methods for mass awakening and massco-operation. And on these four pillars, we shall be able to construct a noble edifice which could be at once the object of pride to us and of wonder for the world.

A Manifestation of Enormous Released Energy.

For the moment, however, we find all round us novel and peculiar phenomenons among our people — Indiscipline, impatience, intolerance, insubordination and intimidation some times with violence, traits unfamiliar to our traditions and culture. It is said that the wine of liberty has gone to the head of the people who are therefore behaving like the mad and if this is continued we may well loose our independence. I, for one, however see in these apparent senseless acts and insane behaviour. the manifestation in our people of a dynamic energy and stupendous power, an expression of their long cherished dream for liberty having come true and a revelation of their belief that the millennium is within sight, that their miseries will soon be at an end and henceforward they will be able to have full meals, proper clothes, decent shelters and good health. The flood is come and it is for the leaders and the intelligentia to take advantage of it and to divert it to such channels as will turn the desert into green pastures. This enormous energy must be guided to practical benefits and that without any loss of time or else utter destruction is inevitable. It is a warning as well as a message of hope. Let no one therefore dare fail. Today time is the essence and the cry should be for all hands to the oar and full speed ahead. And in this co-operative effort, we Engineers must play our part to the full. Let each of us do our work loyally, conscientiously, honestly and to the best of our ability, stoke the coal, produce the steam and maintain and tune the Engine in full efficiency, so that the Captain in the Steering may depend on us against the ship of state being foundered.

Government Outlines its Programme for Development.

In the most admirable opening speech to the Industries Conference at Delhi in December last, our Minister for Industries and Supply Dr. Mukherjee, has given the outlines of the Government's proposals for the development of the country. Under the short-term proposals come, the increase in the capacity of rail transport; starting of hydro-electric projects and ancillary thermal stations ; rationalisation and growth of coal industry; New Cement and Steel factories; utilisation of spare capacities of Ordnance Factories to the needs of industries; production of scientific apparatus; manufacture of medicinal drugs; expansion of research facilities; increase of facilities in India for training of more and better equipped technical personnel; establishment of scientific and technical liaison offices abroad for recruitment of technologists and for proper training of Indian students sent out; increase of production of existing industrial plants and last but not the least an appeal for a truce between labour and capitalists for a few years. The long-term proposal cover the establishment of a Central Planning Committee and planning for all defence industries including iron and steel. chemicals and dyes, automobiles and tractors, aeroplanes and shipbuilding, electro-chemical and nonferrous metal industries. The Industries Conference in which representatives of both labour and capital attended, also passed a comprehensive resolution on industrial production. They recommended that targets for the next 5 years should be fixed for some important industries like Cotton, Textiles, Paper, Newsprint, Chemicals, heavy and light engineering and electric and other machineries and machine tools; with suitable organisation for watching and ensuring progress towards the targets. Further they asked that a Central Industrial Advisory Council should be set up (with appropriate sub-committees for important groups of industry and for problems of transport in relation to Industry) for the definite task of watching and ensuring execution of immediate and short-term plans. Finally at the end of the Conference it was announced that a truce for three years had been agreed to by the representatives of labour and capital so that production is not interfered with by strikes and lockouts. Well gentlemen, this is really wonderful. Considering the terrible ordeals through which our Ministers have been passing since the Independence Day and even now with their numerous urgent pre-occupations, it is a great achievement that they have In such a short time, been able to chalk out their objectives and method of approach. Much remains to be clarified, it is true, and some more time will necessarily be taken to prepare a complete blue print of the industrial development of the country, but it should be clear to all and specially to us Engineers that our Ministers are proceeding on the right lines and are exerting themselves in spite of severe handicaps. We expected nothing less from the band of men and women who are guiding the destinies of our country now and it is up to us individually and collectively to see that they get our best cooperation and services, and we put our shoulders to the wheels wholeheartedly and accept full responsibilities for matters which come within our sphere of activities.

The Bottlenecks which must be Smashed Forthwith.

At the same time as practical men who will have to play a vital role in transforming the objectives into realities, we must in all seriousness urge that a few dangerous bottlenecks should be removed forthwith or else our hopes and aspirations are bound to end in disappointment and possibly disaster.

Relation between Labour and Capital.

Obviously, one of the first essentials for our industrial development is that, in spite of the declared truce, the present relationship between labour and capital must be put on a better footing. The fact is that production everywhere has suffered seriously and at the same time higher wages had to be paid. Strikes and lockouts are common and there is an atmosphere of suspicion and distrust on both sides. The other day Sardar Patel addressing the members of the National Chamber of Commerce, Calcutta, said "It was to restore sanity and fair dealing between labourers and employers and to give a correct lead to labour that we have set up the Indian National Trade Union Congress". "Labour is not being properly led and must be rescued. It is a matter of patience and sympathy. Firmness in dealing with labour agitators and in restoring discipline among labour ranks is indisputably necessary. If we cannot be firm, we might cease to govern. The Government cannot allow intimidators to function with immunity. All three parties—labour, capital and the Government—have common interests and a common outlook in many fields. We must act with mutual consultation. All of us must have courage to face facts and deal with them in a practical way. Hesitancy is out of place; boldness is clearly indicated. But at the same time you should show understanding and sympathy to those whom you utilise as means of production. It is only then that you can win the labour round. You should educate labour into the correct ways of conduct. Public opinion can never be won by following the path of least resistance."

Why Agitators can Mislead Labour.

Wise counsel indeed. Show understanding and sympathy to the workers and educate them into correct ways of conduct. But to understand the labour, its economic condition has to be correctly assessed. There is no doubt that today no one is happy neither the common man nor the worker nor the clerk and not even the higher officials. Everyone feels the pinch of want and everyone has to bear a lot of hardships and to go through a lot of worry day after day. The Control, the inflation, high prices and black markets, difficulty in getting accustomed comfort, uncertainty in procuring necessaries of life in suitable quality and quantity — all have conspired in lowering the capacity and efficiency of the and to the country as a whole. What is the remedy now? How to rescue labour from the clutches of unscrupulous "agitators" and how to make them produce more? There are only two ways — viz, — to look after them and to educate them as Sardarji has said.

Remedy Number One-Look after Labour.

"Of the needs of the workers scarcely any is so important as cheap and decent housing" observed the Textile Labour Inquiry Committee. And " 'decent housing' means not merely better houses but houses in the right environment in the right relation to places of work and recreation and communal activities" says Sir William Beveridge. At the present moment however, provision of large-scale housing for the labour must be a long-term undertaking as the country has not got sufficient building materials to carry out such projects without injuring other more urgent nation building works and therefore we shall have to do what we can to improve matters in other ways. While schemes for housing may be prepared and construction undertaken as far as is practicable, what is an absolute necessity today is that the industries should immediately make an earnest drive to have the existing residential areas of their labour (whether inside their own land or outside), maintained in a clean and in sanitary condition, to arrange pure water-supply, initiate improved sanitary conveniences and to construct, with least delay, suitably furnished community halls, libraries and co-operative stores and to provide recreation facilities and Canteens supplying wholesome food at a reasonable charge. Along with these amenities, competent and sufficient number of Welfare staff must also be appointed whose job will be to keep in constant touch with the labour at home and who must thoroughly identify themselves with the workers' daily life guiding and advising and helping them to lead a clean, sanitary and healthy life and organising and conducting sports, recreations and amusements and thus create an atmosphere by which labour may realise that industry is now anxious for their well being and benefit, and all this will increase his efficiency.

Educate Labour through Propaganda Officers.

Simultaneously with this, another set of people should be engaged to carryon an intensive propaganda dinning into the ears of the labour day in and day out, how important it is for themselves, their employers and above all their country that they should discharge their work loyally, and with efficiency and make the best of what is available. These officials will organise meetings, radio talks, debates and discussions and will in effect take the place of the agitators and it will be their job to stress on the duties and responsibility of labour in relation to the industry as well as their rights and privileges. A strong appeal must be made to their sense of duty and patriotism and to the urgent necessity for the country to step up production. It should be explained that the great bulk of the capital used in industries today, represents the savings of hundreds of people of small means and not of the few rich people only and the profits that can be distributed to the shareholders are very limited now, whatever might have happened in the past. And that the Government takes away in the shape of taxes the major portion of the difference between the earnings and production expenditures and the Government has unequivocally declared that it will not allow anyone to exploit labour. To slow down production therefore will injure not only the capitalists but to a much greater extent the labourers themselves with the result that the country as a whole will suffer. It is the old story of quarrel between the stomach and the limbs when "the latter thought it very hard that the stomach should lead an idle good for nothing life, spending and squandering all the fruits of their labour and actually starved him off, only to find that even he contributed something to the maintenance and welfare of all the parts as they did to his".

If sufficient number of competent staff for this work is not available a group of industries might employ one set of people supplemented by mobile loudspeakers and recorded talks by leaders of the nation.

Propaganda and amenities must go hand in hand and it will be the responsibility of the Managers of each industrial concern to watch personally this most important work. The cost of these will not be beyond the resources of the industry and the Government might allow the expenditure on buildings and furnishing charged to revenue and exempted from income-tax.

Improvement of Transport System Essential for Progress:

The present unsatisfactory working of our transport systems is another important factor in the slowing down of all our national activities. Railways are not carrying as much coal as they used to do; for want of transport, the production of some cement factories has dropped by 40 per cent, essential industries are being fed from hand to mouth and several smaller industries are on the point of closing down altogether. Urgent and drastic measures are therefore immediately necessary to put India's life line into its former vi gaur or else all our hopes for a better India will be shattered to pieces.

What is Wrong with our Railways.

The reasons for the present inefficiency of the railways are complex and varied. Although the number of Engines and goods stock in service now is somewhat larger than in 1938, a higher percentage of them than usual are overage. There is difficulty in obtaining spare parts for repairs and theft of parts from running trains has increased. The usual traffic routes in some cases have changed and some merchants are taking too long a time to unload their wagons. In some railways as a result of the partition of India a large number of specialised staff such as drivers. firemen and mechanics has opted and suddenly left for Pakistan and the gap created will take a little time to be filled up. But these reasons by themselves would not have created the present crisis-these have only aggravated an otherwise deteriorated situation. Apart from the common grounds due to continued worries and weariness among all classes of people for lower productivity, the two cardinal factors working against the efficiency of the railways, which have progressively developed during the last 15 years or so are that the great majority of employees have lost confidence and respect for their superiors in office and that the supervising officials have lost confidence in themselves and control over their men. By introducing and effecting a rigid central control even in matters of details, by preparing and promulgating a series of Codes and Regulations for strict observance by all concerned and by adopting a policy of least resistance in all spheres, the efficiency of railwaymen has been thoroughly undermined. Most officials are now afraid to take initiative and suffer from a sense of frustration and all are immersed in voluminous paper work in report writing and in correspondence and have little or no time for detailed study of special problems and cultivation of personal contacts with their men. Likewise, the workers feel that they are only a part of a machine without a soul and their officers do not understand or care to know their troubles and difficulties and are either unwilling or incapable of redressing them. Under these conditions discipline is bound to suffer and teamwork becomes impossible. And these are the two things essential for satisfactory running of a railway.

To remedy matters now, the Government must retrace its steps and remodel the entire structure of railway administration. There must be complete decentralization of authority and power and thorough overhauling of working methods and procedures. Discipline has to be restored by sound leadership and personal contact with the staff.

Decentralization of Power and Authority—an Urgent Need.

In my opinion, time is overdue when the Railway Board should cease to be Managing Agents of all the railways. Its function should be analogous to that of the Board of Directors of a company, viz. — formulation of policies, co-ordination between the railways and scrutinising of the budget, the actual management being left to General Managers, who should be invested with full powers and be made responsible for financial and operational results. Similarly, the General Manager should delegate most of his powers to the Heads of Departments and the District Officers must be given adequate authority to carry out executive matters without interference. For dealing with the staff, stress must be shifted from regulations and procedures to personal contacts, sympathetic treatment and appeal for patriotism. There must be firmness in demanding and obtaining a higher quality of work and at the same time patience and willingness to understand and appreciate, and if possible remove their difficulties. Lead rather than drive should be the motto.

There is no dearth of talents in Railway service and the employees of all classes are generally thoroughly loyal and wish to maintain and feel proud of the good name of their own railway. If they are given chances, directed properly and treated with sympathy and understanding I have no doubt that the recovery will be rapid and lasting.

It is a great pity that the Railway Enquiry Committee which was appointed some 18 months ago under the Chairmanship of Mr. K. C. Neogy, had to suspend its work without completing the investigations. But in view of the extreme urgency of putting the transport services on sound footing I would strongly urge the Government to revive the Committee without further loss of time, obtain its recommendations early and take positive action with speed, courage and determination.

Banish Dilatoriness from Government Offices.

The next important matter to which our Governments must give their immediate and serious consideration is in respect of speed of work and in this also patchwork will not do. A bold policy and thorough overhauling of the Government Offices, their methods and practice are urgently called for. For sometime past we have been accustomed to dilatoriness in all Government offices. Hemmed in with countless rules, codes and procedures, we, more often than not, had been accustomed to loose sight of the purpose behind the form. In his address to the Educational Conference last month Pandit Nehru complained that "although many reports have been submitted by various Committees on different subjects and work was being done on them, it was a pity that it was being done so slowly and urged that work may be accelerated". I am bold enough to point out to our respected Prime Minister that before we could get things moving at even a moderate speed, the entire procedure and outlook of all Government offices must be changed and a new code of conduct has got to be introduced for their officials.

Trust Your Officers and Invest them with Responsibility.

Today no officer is fully trusted nor is he certain of support in case of a difficult position. He has therefore got into the habit of looking for guidance from the top all the time and he generally arranges matters so, that on paper he can always shift responsibility on some one else. Codes and rules have been prepared on the fundamental basis that no one can be trusted to do the right thing but every one must have a watch dog lest he violates some canons of propriety. A tight control from the top in all matters was therefore rigidly enforced. If the objective of straight conduct boy all had been attained, there would be some compensation but hundreds of these codes hardly prevent the dishonest officer continuing his evil acts, but only make the honest workers' job more difficult and more tiresome and create an enormous amount of writing and correspondence and an atmosphere in which healthy growth of sense of responsibility is impossible. Take any file in any Government office and it will be found that for want of quick decision and prompt orders, simple letters go from one table to the next, from the junior-most clerk to the Deputy or to the Secretary each putting down something for the next higher official to add. In this way what could be done in any business house in a day is hardly done in a month in Government offices, as a host of people deal with the same matter, but no one would take the responsibility for a decision on his own. The total loss of manpower in consequence must be colossal. But what is still more serious is that each official finds himself buried in paper work, leaving too little time for study of special problems. Government official henceforward must be made to take full responsibilities attached to his post and not allowed to pass the baby from one arm to the next. His clerical staff should be cut down drastically and he should be encouraged to make quick decision and to issue orders promptly. If he makes mistakes he will soon find them out and correct himself and if needed his superior officer could advise him quietly. Unless an atmosphere is created and sustained for the official to take initiative and carry on his work in his own way with full responsibility for the results, his qualities, however high they might be initially, are bound to deteriorate and he gradually loses confidence in himself and respect of his subordinates and when this happens, he can be of little use to a progressive administration.

Less References to Other Ministries:

Brakes are now also applied by the necessity for schemes costing more than a certain low financial limit to be considered by the Standing Committees and also for all schemes by one or more Ministries besides the Ministry which initiate them. Even when funds for a scheme are provided in the passed budget, it has to go through the so-called scrutiny of these bodies and ministries each of whom takes considerable time to come to a decision as they have to be first given a complete explanation of the why and how of the scheme. The background is the same, viz., distrust in the capacity and reliability of the Minister-in-Charge and the experts engaged by him to prepare and finalise any scheme on their own. These hurdles have got to be removed and conditions created by which the Minister-inCharge should be the final authority to sanction a scheme, provided a provision exists for it in the budget. If he needs, he would himself consult others but let him be placed in a position to act quickly when he is satisfied with the necessity for it.

Obstacles in Execution of Works.

When the scheme is at last sanctioned by the competent authority, it goes through a series of obstruction at many stages before actual work can commence. A common mould has been prescribed for all works and no variation is allowed. Even though the Executive Officer has been invested with a schedule of powers, he has to submit himself for advice and approval to various controlling authorities, both financial as well as administrative, on even comparatively simple matters and each reference means a lot of writing and loss of valuable time. The other day our renowned Scientist Dr. Meghnad Saha complained "that the Government of India has been announcing from time to time their intention of establishing a number of' scientific laboratories for national work, chemical, metallurgical, fuel, glass and research laboratories. He had been member of various committees and he thought that he had made himself odious by drawing pointed attention to the extraordinary delay in carrying out the plans. He added that the idea of starting a National Physical Laboratory was first mooted in 1942 and a Planning Committee was appointed which just took four years to evolve out a plan containing bare 20 pages. He thought two months was sufficient for this task. But the Government in this country, Prof. Saha continued, seemed to think that scientists were fools and no work was good enough unless some politicians or industrialists were asked to serve as Chairman. I think at the present rate of progress another 7 years will be required before the buildings for laboratories are complete and fitted with apparatus 8,0 that Indian scientific work on a national scale cannot start before 1954".

Continuing Dr. Saba said "Contrast with this the work of the Harwell atomic energy station in England where the first sod was turned just a year ago and now it is a flourishing station containing huge laboratories stocked with all kinds of latest apparatus and housing nearly 300 scientists and bristling with activities. I think the Government of India should take a lesson from this example and they should not forget that Time is the Essence of Everything. We have liberated ourselves from our alien rulers, but not from the procrastinating methods invented by them". Most of us can quote many such instances in almost every field of Governmental activities.

Inefficient Working of Control and Priorities Responsible for Slow Work and Loss of Available Man Power:

Added to these, go-slow methods for saction and execution, the inefficient working of control, priorities and license is now affecting progress of all works. Today every Engineer in charge of works, whether employed by the Government or by industries has to waste a lot of time daily chasing several Government offices for some permit, license or priority and it is common knowledge to all of us that smooth progress of work is hampered repeatedly for want of some kind of facility or other. One work remains standstill for want of Cement, for instance, another for supply of steel and a third one for transport of essential materials available in plenty but which cannot be moved, But few people realise, that the effect of such intermittent stoppages of work, is that the entire constructional organisation is upset involving not only idle machineries but also enormous waste of available manpower of all ranks earmarked for such work from the Engineer to the daily labourer. And this at a time when there is acute shortage in the country of workers of every grade and of materials of every description. It is commonsense that longer the time required to complete a job, and to bring it into use, greater becomes the demand on our limited resources of men and material, as a lot of them remains blocked and unproductive. Meanwhile it increases work and correspondence in every office. Take Steel for instance. We all know that during 1947, production has suffered by about 25 per cent but actually quotas and allotments for even the first quarter of 1947, have not yet been met in full. Does it not indicate that licenses are issued without due consideration of actual productions.

Wanted a Machinery for fixing Priorities of all work and Co-ordinating them with Production:

I would therefore urge that priorities be fixed and classified for every approved scheme at the highest level both in the Union as well as in Provincial Governments and only those works are allowed to be actually taken in hand which have a reasonable chance of getting all materials and facilities. A special, machinery is required to be set up for co-ordination between planning, priorities and productions. For instance, the Government of India and Provincial Governments have been contemplating to execute several Hydro-Electric Schemes. But it would not be in the interest of the country as a whole, to start work on all these projects immediately unless some machinery has examined the possibility of providing all of them with materials and facilities for early completion. This authority must also consider all other major schemes required to be executed simultaneously with the hydro-electric schemes and decide on the particular projects to be taken in hand. Otherwise, the progress of all of them will suffer. Rationalization of priorities and control is essential for proper and economical utilization of manpower and materials, both of which are admittedly in short supply in the country.

Technical Education—Institution of Engineers are Vitally Interested in it.

Any planning for economic development of the country must demand immediate and careful consideration as to how best to train up the thousands of technical personnel who will be required to translate the ideals to blue prints and plans to actualities.

One of the main objects for which the Institution of Engineers was constituted 27 years ago. was, to quote from our Charter "to encourage, regulate and elevate the technical and general knowledge of persons engaged in or about to engage in Engineering or in any employment manual or otherwise in connection there with" and the Institution has always taken deep interest in Technical Education in the country. The Institution has its own syllabus and courses of studies and conducts its examination to enable those who pass the test to become its members. It also recognises, after thorough scrutiny of the standards of studies, teaching and of equipments, diplomas and degrees of many Technical Institutions and Universities as equivalent technical qualification for elligibility for its membership.

Report of the Committee of Institution of Engineers on Technical Education.

When the recommendation of the Central Advisory Board of Education (commonly known as Sargent Report) was published the Institution appointed a Special Committee to go into that part of it which dealt with technical education. Curiously enough the Government at that time while appointing the Board did not consider it necessary to include any Engineer or Scientist in this Board which was filled up by politicians and members of Education Department in the Central and Provincial Governments. The Report of the Institution's Committee was duly sent to the Government of India in 1946, for consideration as in certain vital matters we differed from the Sargent Report.

While India was in a State of Somnolism, West have made Important Higher Technical Education and their Interim Recommendation.

Meanwhile the Government appointed the All-India Council for Technical Education composed of representatives of Central and Provincial Governments and those of labour and industrialists, of Engineers and Principals of Engineering Colleges and of course some politicians. This Council started its work in 1946 and by November, 1947, submitted two definite recommendations to the Government, viz., (1) to establish immediately two Higher Technical Institutions one near Calcutta and the other near Bombay and planning for two others one in the north and the other in the south and (2) to provide financial- assistance both recurring and non-recurring to 14 existing Engineering and Technological Institutions in the country with a view to improving standard of education imparted in them. Final orders of the Government in these have not been issued yet, but it is hoped that they will be issued without further delay. These recommendations however concern the higher technical education only, which will produce Engineers and managerial staff but little or nothing has been done by the Central or most Provincial Governments towards the training of the much larger number of men of other categories such as supervisors, charge hands or foremen-technician and mechanics and also craftsmen and skilled workmen.

Neccessity for Increased Output of Supervisors and Technicians and Providing Educational Fecilities for Them.

As the Institutions which the All-India Council are sponsoring will ultimately turn out a total number of 10,000 Engineers per year, the country will need at least 30,000 Supervisors and Technicians and a huge number of craftsmen and skilled workers, a sound technical education for these people is essential for efficient execution or different projects in contemplation and every Provincial Government must get busy without further delay in formulating its schemes for development and co-ordination of their training.

Provincial Governments should Appoint Technical Secondary Education Committees.

As far as I am aware Bombay is the only province where the Government has appointed an Industrial and Technical Secondary Education Committee to deal with this matter. Similar steps should be taken by other provinces also, so that training of all classes of technical men goes on simultaneously and in accordance with a definite plan and requirements of particular categories of technicians and craftsmen for each area. It must be remembered that apart from theoretical training five to ten years practical experience will be needed by every technician before he can be proficient in his own field of work. No time should therefore be lost by the Governments to start their surveys and re-organise and expand their Schools. Similarly for craftsmen and skilled workmen expansions and improvements of trade schools are an urgent and immediate problem.

While India was in a state of Somnolism, West have made Important Discoveries.

The fact has to be faced however that as a nation we are extremely backward in technical bias and knowledge-not that we are less intelligent but that so far we have had little or no chance. Up to about two centuries ago the knowledge and performance in Engineering and industries in India were on a par with any other country in the world. Some of our buildings, bridges, dams, Textiles and metal works were actually superior to those obtained elsewhere. Then India became a conquered country. And while we were in a state of somnolism, the free and energetic people of the West had discovered, worked and improved the Steam Engines Electricity and Wireless, and all kinds of mechanical equipments and had revolutionised methods of construction and production in every sphere of activity and today we are a century behind them in Engineering and technology except what a very very few of us could pick up during the last 40 or 50 years. To the vast majority of our people, these developments are a sealed book and only a few have a glimpse of it. But now that India has become free, it is essential that we should all fall in line with the advanced countries and be initiated into mysteries of applied sciences and some must have mastery over them.

The Whole Nation has now to be Machine Minded.

How to pull up the arrears of a century and create a bias in the minds of our people for mechanical evolution, must be the serious concern of our leaders, Scientists and Engineers.

To make our vast population scientific and machine minded we should in my opinion follow the methods so successfully adopted by Soviet Russia. Professor Ashby of the University of Manchester and some time Chairman of the Australian National Research Council writes in his book "Scientist in Russia" "It can be said without fear of contradiction that no where else in the world, not even in America, is there such a widespread interest in science among the common people as there is in Russia Science is kept before the people through newspapers, books, lectures, films, exhibitions in parks and museums, and through frequent public festivals in honour of scientists and their discoveries. There is even an annual 'olympiad' of physics for Moscow school-children in which they solve problems in a competition on the lines of a 'knock-out' tennis tournament; and then gather in the University to see experiments illustrating the answers, and to applaud the prize-winners as they take their prizes from the hands of some famous physicist." And again, "Russia has endowed science with the authority of religion. Science has a privileged place in the school curriculum; it is the main subject of study in hundreds of institutes of higher education; its plans are woven into the plans for national development; it is admitted to the highest councils of the country it is generously endowed with money and men. Science carried out with an eye to its practical application is specially encouraged ".

Necessity for Including Scientific and Technical Subjects in our Basic and Secondary Schools

Our learned and revered Minister for Education is now engaged in framing the details of the new system of education for children as well as for adults. I would appeal to him to include some scientific and technological subjects in the curriculum of schools of all grades. There is no doubt that, as stated in the Revised Syllabus for Basic Schools, "the training in personal and collective cleanliness, health-teaching and social training form the chief part of the education of young children". But if gardening and weaving had been introduced in the syllabus in order to develop manual activities of the children, there is greater necessity at the present time for them to be familiar with and handle mechanical contrivances of some kind or other. They may therefore be put to assemble and work motion toys and observe and follow up the working of toy prime-movers, machine tools and the like. This experience and knowledge will be a great asset to those children, who later on, are admitted to junior Technical Schools and Technical Colleges but even for those who take up Arts and literature, etc., a correct idea of working of machineries and natural energies will be invaluable at the present age when every one, no matter what vocation he takes up in life, must use some of these in one way or another every day of his life. Special Educational films illustrating the working and achievement of science and technology must also be prepared and exhibited and popular lectures or recorded talks on them, from as many platform as possible, should be a regular routine work in every school throughout the country. We cannot attain our objective of a higher standard of living for our people if we shut our eyes to the marvels of this century and confine ourselves merely on manual work.

For those who believe that with our vast population we shall be better off without introducing machineries in our industries I would quote the following from the Reader's Digest of December: 1947. "From John L. Lewis's testimony before the House Sub-committee on Miners' Welfare.

"Many years ago the British miners' union, the British Federation of Miners, officially opposed the introduction of machinery in the mines for two reasons: that it increased the hazards (which was not necessarily true); that it destroyed work opportunity and augmented unemployment. The British mine owners were perfectly content to accept that point of view. They preferred to take out their profits and plow little back in the way of improvements.

"The United Mine Workers of America at the same time took the position that the only way in which the standard of living could be increased in America, and in the coal industry, would be by increasing productivity and lowering the unit costs by utilizing automatic and semiautomatic machines to do the work of human hands. The United Mine Workers educated its membership through the years to an acceptance of that policy against the inherent opposition that existed in the industry when the first "iron man" came into the coal mines.

"The result has been that the British mines have become obsolete in every economic sense, and England is staggering economically because of that fact. On the contrary, here in America we have increased the mines' productivity per day until it is now six times that of Great Britain, and coal is delivered to our consumers at prices less than one-third per ton of the cost in Britain. Yet the industry pays a wage structure, on a weekly basis, three and half times that of Great Britain''.

Training of Specialists.

At the other end of the scale, we shall have to think of and find out how we can increase the number of Specialists in Engineering and technology in the country. This is bound to take a little time but a beginning must be made now and on sound lines. Full scope and encouragement are required to be given to our own men for planning, designing and execution. High class Consultants and Advisers may be recruited from outside on short-term contracts, on their own terms, to check up, criticise and suggest improvement of design or plan or method of work but our own Engineers must be intimately associated with them in all phases of the work and in fact they must be made to feel that the responsibility for the job is theirs, the foreign experts being there to help them with their greater experience. We should not import from other countries ready made plans and designs or entire constructional staff for any scheme on the ground of easy solution or promises of quick results.

I understand that a suggestion has been made to the Government of India to import a band of foreign Engineers and Contractors to prepare detailed plans and to execute a big hydro-electric project to be sanctioned soon. If this is a fact, I would advise the Government not to agree to this proposal. Let a minimum number of Specialists be imported by all means, but our own Engineers should have their chance. It may be necessary to send out a few capable and young Engineers with 10 to 15 years experience to foreign countries, under the guidance of the Specialists to study the working of particular schemes, appliances and plants, it may be necessary to recruit a few technicians to erect and operate some special plants but it must be on a purely temporary basis for a short time with the clear understanding that our own men must pick up the job in a fixed minimum period when the foreign Specialists and Technicians will be sent back.

Prof. Ashby says "The reader may wonder how, in less than three decades, the Russians have produced trained men for these prodigious scientific activities. Here, indeed, is the Achilles' heel of scientific planning in Russia. The enthusiasm of the planners has outrun the human material available to them and instead of building slowly, they have thrown up more' and more institutes and filled them with less and less competent workers. Whether it was wise or unwise, it is rapidly becoming outgrown, for education is beginning to catch up with the planners of science". And again—" A Great quantity of scientific work is done in the Soviet Union because a great number of workers has been mobilised to do it. The quality of scientific work, in the Soviet Union as elsewhere, is no better than the quality' of the worker. There are many first-class men whose work is important, but the general level of accomplishment is lower than one might expect, because of the greater dilution of first-class men by hack workers. Nevertheless science in the Soviet Union is ambitiously planned, well endowed, vigorous, and healthy; and even if its record over the twenty-five years is not astonishing, its promise for the future can hardly be over-estimated ".

Institution to Form Standing Committees for some Branches of Engineering.

In this matter, the Institution of Engineers have a clear duty. We must form a number of small standing committees of the Institution OD various branches and sub-divisions of Engineering composed of men with sufficient knowledge and experience on their respective subjects and who would be prepared to devote a certain amount of time to study and direct schemes proposed by the Central or Provincial Governments. For instance, we could have on the Civil Engineering side Committees on Roads, Housing, Irrigation, Sanitary schemes, Town planning, Bridges and Railways,—i.e., in spheres where experienced men are available in the country. We can then tell the Governments that they need not go out and import men from elsewhere to direct or vet their works or research programme on such subjects. The Roster which has just been prepared for members of the Institution will be of great help in formation of these Committees and I would ask the Council to take up this work immediately and in right earnest.:

Institution Research Committees.

During the past few years, the Institution through its Presidents have been urging the Government to provide facilities for Engineering Research. But at the moment we have no machinery to follow up this important subject and to make sure that the proposals of the Government in this respect are adequate for the needs of the country. I would, therefore, suggest for the consideration of the Council that a Committee be appointed composing of the three chairmen of Civil, Mechanical and Electrical Sections and say three other members for studying the steps taken or proposed to be taken by the Central and Provincial Governments towards establishment of Engineering Research Stations and to suggest any additions or modifications required in their organisation, equipments and working.

The Three Giants of our Time.

In recent times the world had produced three giants among men—Gandhi, Lenin and Sun Yat Sen. Each had dreamt and worked for the emancipation of millions of his countrymen and each had the satisfaction of accomplishing his task. Each of them had hoped that as the result of attainment of freedom, his people will be happy and prosperous and contented.

Lenin and His Successors Attain Their Objective.

Immediately after his first objective was fulfilled Lenin called on the Russian Academy of Sciences to make a scientific survey of the natural resources of the country and prepare a plan for their development and for the economic recovery of the country. He also appointed several Committees with hundreds of Engineers and Scientists for elaborating the plans, to provide detailed Schemes and to carry them out in stages. After Lenin's death, his worthy successor Stalin continued his work in the same spirit and within a period of fifteen years raised his country's productivity twenty times and made his people so strong that they could not only withstand the unprovoked attack of their highly industrialised and mighty neighbour, but overpowered and defeated him in his own game.

Internal Dissension Leads to China's Unfulfilled Dream.

Sun Yat Sen also had a plan for industrial revolution in his country but his people beset with internal dissensions and strifes, started a Civil War and for the time being all his dreams vanished into thin air.

The Mahatma the Apostle of Peace gives up His Life so that We may Live.

Is it possible that apprehending a similar fate, the Father of our nation, from the moment political liberation of the country was in sight, devoted his entire time and his limitless energy in preaching and fostering his message of peace and good-will among his people and has now laid down his life for that mission so that his erring countrymen may yet follow the right path and live? When he started his last fast, only a few days before his cruel assassination, did he not repeatedly remind us that the first essential for reaping the fruits of our freedom is to give up our fratricidal inclinations and activities, to abandon our factions and power politics and to remove bitterness, hatred and suspicion between brother and brother? Let us hope and pray that his martyrdom will at last wake us up to realities and make us see things in their correct perspective. Let us hope that the flames which consumed the mortal remains of this greatest man of our age, will continue to illumine the hearts of his countrymen so as to enable them to follow the ideal for which the Mahatma lived and died.

Our Leader-Pandit Nehru and our Duties.

To carry on the consummation of our liberty, we have, fortunately in our Prime Minister Pandit Nehru a great leader and a man with vision. courage, energy and determination. He knows well, as he has said on many occasions that "the problem for the country today is one of filling hungry mouths". He also realises that this problem can only be solved by scientific utilization of the enormous resources of power and materials which nature has bestowed on us in abundance. His long experience as the Chairman of the National Planning Committee has fitted him to assess .and to determine the stages of development required for the progress of the country. I Let us therefore rally round him, let us assure him of our loyalty, and sincerity of purpose. Let us tell him that he can depend on the 4.000 Engineers of this Institution who among themselves recognise no barriers of Caste. Creed or Community to contribute their full share in 'raising our motherland to its proper place among the nations of the world and who are determined to see that his dreams and ours come true.

JAI HIND

Rai Bahadur Dr A N Khosla

M.I.E., I.S.E.,
Consulting Engineer, Government of India and
Chairman, Central Waterpower, Irrigation and Navigation Commission

President 1948-49 & 1949-50

Presidential Address

(1948-49)

Your Excellency, distinguished visitors and brother Engineers.

It is my pleasant duty and proud privilege this morning to welcome Your Excellency to this 29th Annual Meeting of the Institution of Engineers (India).

I am grateful to the Council of the Institution for the honour they have done me in electing me President of the Institution of Engineers for the year 1948-49.

I value this great honour but more than that I value the opportunity for service to the profession and through that to the country. I am conscious of the heavy responsibility which. this office carries and more so of the limited time at my disposal to discharge this responsibility. I, therefore, look forward to the co-operation of the Council so that together we may strive as a team and add another year of achievement to the onward career of this great Institution.

The Institution.

This Institution is the smybol as well as the measure of our creative genius. Its purpose does not lie so much in the enrolment of new students, associates and members nor in the conferment on them of passports for appearing in competitive examinations or qualifying for positions of power and responsibility. It lies rather in the promotion, advancement and dissemination of technical knowledge required to sustain and stimulate the newborn creative and constructive urge. In the modern world, the strength and prosperity of a people will be determined more and more by the advances and achievements in the technical field. It will be no exaggeration to say that, you Engineers are the makers of New India. On your efforts and achievements will depend the pace and pattern of the moral, economic and political advance of the Nation.

In view of the vital role that engineers are going to play in moulding the future of the country, the progress of this Institution assumes special importance. This Institutions should not be a pale reflection of some foreign institutions, depending for its growth and usefulness on lessons from abroad. It must thrive on inspiration and strength from within and thus develop into a dynamic and live organisation which by assimilating all that is best in world knowledge should make its due contribution for the progressive enrichment of that knowledge. The corporate membership of this Institution should be no mere formality. It should carry with it the pride of the profession and should be a constant reminder of the vital role the Engineer has to play in shaping the future of the country and of the ceaseless effort required of him in harnessing its natural wealth in the service of the common man. Our newly won freedom has opened to us the floodgates of opportunity. It has brought home to us a realisation of the vast natural resources of our country, and, in the context of modern technical advance, of the unlimited possibilities for their development and utilisation. In no country and in no generation, did the engineer have such wonderful and virgin fields suddenly thrown open to him for the exercise of his initiative and creative genius. Opportunity is at our door-step. It is for us to take it and by making the best use of it, raise our country to the highest place of glory in the service of mankind.

Fundamental Problems.

I now turn to a review of the many problems that face the country and call for the special attention of the engineering profession. The two fundamental problems are food and cheap power, the solution of which will constitute our major task for many years to come. The other problems are clothing and housing; the manufacture of essential machinery, the setting up of basic industries and a general drive towards all-round resource development, which are so necessary for national well-being, self-sufficiency and integrity.

Food

Our first problem is food. We produce nearly 42 million tons of food-grains and we are importing nearly three million tons every year. For 1949, I am told it will be <1 million. Apart from emphasising the dangers inherent in a lack of national self-sufficiency in respect of food, these imports involve a drain of over 100 crores of rupees on our resources in foreign exchange. It will be 200 crores in 1949. Of this over one-fifth is from the dollar area. Until two .years -ago, India had a favourable balance of trade with the U.S.A. Today it is unfavourable to India largely because of the need for import of food-grains. An increase in the production of food-grains in India would release dollars and other foreign exchange sorely needed for the import of heavy machinery required for the development of India's natural resources for purposes of agriculture, industry and mass uplift. The production of food-grains must, therefore, have the highest. priority in our programme of resource development; and not only must we wipe out the existing deficit but must provide for progressive increase in production to meet the needs of the four million annual increase in population.

Land and Water Resources of India.

But have we the means with which to raise more and more food-grains? The answer is very much in the affirmative. India has an arrable area of 450 millions acres of which only 300 million acres are raising crops, and indifferent crops at that. Inefficient farming and lack of manure are among the contributory causes for low yields, but the determining cause for vast areas lying unproductive is the shortage or almost complete lack of water required for raising crops. Besides, there are certain large areas throughout India which suffer from too much water in certain months of the year resulting in damage to crops and floods, and too little water in other months occasionally resulting in famine conditions.

India has immense water resources. The annual flow in the Indian rivers is approximately 1,300 million acre feet, representing a steady flow throughout the year of 1.8 million cubic feet per second. Barely 6% of this enormous water-wealth is being put to beneficial use and the remaining 94% is permtited to run to waste frequently doing untold damage to life and property in its passage to the sea.

Conservation and Utilisation of Water Resources.

Water is the key to the solution of most of our problems. It is needed for irrigation of lands to produce more food; for domestic water supply; for the generation of hydro-electric power; for purposes of industry, agriculture and manufacture of fertilisers; for feeding the vast network of inland waterways to enable cheap, expeditious and wide distribution of the products of agriculture and industry; and for providing facilities for fish culture to raise protective foods for the masses. Water is a perennial and inexhaustible asset and any development based on its use will be of a lasting nature. The conservation and utilisation of India's water resources is thus the biggest and most urgent problem. It is the privilege of you engineers to have to solve this great problem for immediate and future needs.

Nature has been unusually kind to this country. The water-wealth, besides being abundant, is generally well distributed over its various regions. There are, however, certain waterless areas like the desert wastes of Rajputana, where even drinking water is a serious problem. But to most such areas water can, within limits of engineering and economic feasibility, be carried from nearby or distant stream in the same catchment or across adjoining catchments.

A number of river valley development projects for the conservation and utilisation of river waters, namely, the Bhakra, Hirakud, Damodar, and Tungabhadra Dam Projects, are under execution. Others, including some major ones in C.P. are under preparation. If all these projects were to materialise, a steady annual expenditure of nearly 100 crores of rupees continuing over several years, will be involved. This sum is no bigger than what we are spending on food imports. But the additional yield in food-grains alone will be worth many times that figure. Besides, these will provide enormous blocks of hydro-electric power (running into several million kilowatts), large measure of flood control and extensive navigation facilities.

Water-power.

What is true of the water potential of India is more or less equally true of its water-power potential. It is generally well distributed over the entire country and such areas where the power. potential is low or absent, are within economic transmission distance of potential water-power sites. In this respect India is very favourably placed compared to any country in Europe or even U.S.A.

Our next fundamental need is cheap power. It is needed for agriculture, fertilisers, industry and rural electrification. Power can be produced from coal and other fuels or from water. Our reserves of coal, particularly high quality coal, are limited and the latter is otherwise required for metallurgical use. On the other hand, water resources are almost unlimited and inexhaustible. Both from the point of view of permanency as well as installation and operational economy, it would be best to develop power mostly from water. Thermal stations should be limited generally to coal bearing areas, using only low grade coals and should otherwise be installed to serve as nursery stations to build up load in advance of the operation of water-power stations. There will be cases where, to secure overall economy in the use of available water supply or for firming up secondary power, the installation of large thermal stations may be justified; but except in extreme cases, better results will be obtained by linking up adjoining water-power stations in a grid. The pooling of power potentials so obtained will invariably result in increased firm power output at the various linked stations.

India's water-power potential has not so far been worked out. It may be 40 million k.w. or more. The present installed capacity is just under. half a million k.w, of water-power and nearly one million k.w. of thermal power. The annual per capita consumption of power in India is 12 kilowatt hours against 855 in U.K., 1775 in U.S.A., 3580 in Canada, 1717 in Switzerland, 3579-in Norway and 1743 in Sweden. This gives a measure of the magnitude of our task-and of the vast opportunities that lie ahead of the Engineer.

As water constitutes the very basis of our national existence and as all development, in whatever direction, directly or indirectly flows from his source, the development of our water resources must be our first concern, and must, therefore, be given the highest priority among all schemes of development.

Manufacture of Power Plant in India.

At present we are importing most of the electric plant and equipment from foreign countries. In view of the immense scope for electric development in India, it is most necessary that this plant and equipment be manufactured in the country. This will not only lead to overall economy but will be a most valuable insurance in the event of a national emergency arising. The Government of India has decided to undertake the manufacture of hydro-electric and thermal plant and the implementation of this decision may be expected within the current year.

Other Industries.

India has vast mineral resources. Most of these, however, are lying unexplored and untapped. The output of essential materials like steel is only a fraction of her present day requirements and these requirements will increase manifold with the new development schemes coming into operation. The output of aluminium is insignificant. In view of the shortage of copper in India, enormous quantities of this metal will be needed for the thousands of miles of high and low tension transmission lines to be constructed for the great hydro-electric and other electricity projects.. In addition to essential metals, there is need for more textiles, oils, chemicals, and a host of other industrial products, required for self-sufficiency and if possible, export. Our fundamental need, however, is the manufacture of heavy machinery for the production of essential goods.

It will be for the engineer to bring about an improvement in technique and design, devise new processes and materials, improve production and cut down-costs. He may be called upon to take up key positions in the administrative field to dispel the present sullen mood of labour and the apathy of the industrialists which between them are mainly responsible for decreasing production and industrial stagnation.

A happy example of great industrial advance, in the absence of all essential raw materials is that of Switzerland. This land locked country has very little of natural resources except waters from its mountains which provide cheap power. It is deficient in food because of insufficient culturable land. But this country has an intelligent, industrious and virile population of nearly 4.5 million who by their brains and muscle, more than make up for the shortage in natural resources. They import all the raw materials from far off countries and turn out finished goods at competitive rates. They manufacture all types of heavy machinery and other materials. Research in the technical field has reached a high water mark in this country. The standard of living of the people is among the highest in the world. .

Research and Training.

It is in the manufacture of heavy machinery and development of other industries that the engineers will find the best opportunity for research and invention. Until recently we have been content to live on the inventions and discoveries of outsiders and to leave all initiative in this direction to them. This state of affairs must change. We must now initiate research in India in all fields of activity. It will pay handsome dividends in better and cheaper designs and processes of manufacture and in imparting inside knowledge to our nationals. Failing that, in respect of invention and technological advance, we shall continue to be the camp followers of the so-called advanced nations of the West. We are sending scores of our graduates for technical training abroad but no training can be worth while if it is merely that of an observer. Real training comes through personal initiative and experience coupled with direct responsibility for execution. This can be possible only if we set up our own institutions. There may be mistakes in the initial stages, even costly mistakes, but the cost of all these put together will be an infinitesimal fraction of the money worth of consequent knowledge and experience and the ultimate saving in costs of manufacture. There will be the additional-asset of national self-sufficiency. Out of this effort at national self-help, will emerge a band of engineers who will contribute to world science and technology as much as, if not more than, what they take from it. That will give our engineers a more dignified status than the present which generally is one of all "take" and no "give".

Need for Early Implementation of Development Schemes.

In our planning and in determining priorities for execution, we must keep in mind the fundamental objective-the uplift of the common man. The village accounts for 87% of India's population. Their care should be our first concern. We have to move fast, lest hope delayed maketh the heart sick. The common man, particularly since the dawn of freedom, has been looking forward to the fulfilment of hopes which have been held out to him from time to time. Now there is danger of delay because of inflation and the ascending spiral of high prices. But inflation notwithstanding we must proceed with our schemes of resource development. The proper way to combat inflation would be, not to stop productive effort and thus permit human material to stagnate through lack of opportunity and incentive but to freeze surplus purchasing power and canalise it into means of production.

Integration of States.

The integration of States, brought about during the past 17 months has been a miracle of statesmanship and achievement. It is the one outstanding event which more than any other has paved the way for a rational and integrated all-India plan of development, unhampered by the limitations of territorial boundaries and conflict of interests. In the past development plans have been held up indefinitely due to lack of understanding and agreement between the State or between the States and Provinces. It will now be possible to proceed with the regional development of river valleys under a basin wide plan, with the location of industries in the best interest of the various regions and the country as a whole and with the all-round resource development on rational and most economical lines.

Appeal to Engineers.

Brother Engineers, our profession is on trial. The floodgates of opportunity have been opened to us. There is unlimited field for the exercise of our initiative, skill and creative genius. The many limitations in our way have been removed by the dawn of freedom and the subsequent integration of States. The common man is looking up to us for the betterment of his lot. There is a universal demand for achievement and not for plans and more plans. And remember, the British are no longer here to take the blame for our inaction. Shall we rise to the occasion and show achievement or shall we revert to the ways of old days and take shelter behind the cavalcade of real and imaginary handicaps, in the shape of limitations of materials and technical skill, bottlenecks of transport and the new spectres of inflation and rising prices. I am in no doubt as to your reaction. You shall achieve, obstacles notwithstanding. But in the approach to your new task you have to remember that it is not enough to achieve in isolation. It is necessary that you should take the common man into your confidence at all stages of your activities and educate him into the why and wherefore of your plans and designs, so that he may feel from the very start a genuine bond of kinship in your creative endeavour, and prepare himself in time for utilising the fruits of that endeavour. You should get away from the habit of keeping your nose down to the grindstone. You must come out of your shell and take active interest in the life of the people around you. It is most essential that you engineers do exercise a more effective voice in the administration of the country and bring to bear on this administration, your special attributes of precise thinking, balanced sense of values, organisational skill, understanding of human psychology and above all tenacity of purpose in the achievement of the objective. No longer should you be content to be represented by intermediaries outside our own profession. Through creative effort, ceaseless application and selfless devotion to duty you should move steadily but surely forward in your noble task of building up a New India.

JAI HIND.

Presidential Address
(1949-50)

Your Excellency, Distinguished Visitors and Brother Engineers,

It is my proud privilege to welcome you to this 30th Annual Meeting of the Institution of Engineers (India). Coming as it does just two days after the inauguration of the Indian Republic and in the home province of our revered first President Dr. Rajendra Prasad, this meeting of the Institution has more than usual significance. It will we hope, mark the beginning of a new and glorious chapter in the life of this great Institution-a chapter of dynamic and realistic approach to the problems of resource development and utilisation in India for raising the standard of living of the common man.

I am most grateful to the Council of the Institution for the honour they have done me in electing me their President for the second time in succession. I greatly appreciate this gesture of confidence.

In January, 1951,before the next Annual General Meeting of the Institution, there will be held in India the sectional meeting of the World Power Conference (for which the Institution constitutes the National Committee) and the plenary session of the International Commission on Large Dams, the International Association for Hydraulic Research and, perhaps, the International Commission on Irrigation. At the same time we propose to hold in Delhi a grand Engineering Exhibition. in which, we hope, many countries of the world will actively participate. To the first three of these international bodies, I, as the representative of India, have been elected Vice-President. Because of this and the important developments ahead which may vitally affect, the scope and usefulness of this Institution, I decided to accept the honour and the responsibilities of a second term of office, in spite of my extreme preoccupation with my normal official duties and allied national and international activities.

The Institution.

I shall first of all deal with the progress and problems of the Institution.

The Institution of Engineers (India) is, if I may say so, still in its infancy. The membership is barely 30 per cent of the total number of qualified engineers in the country, as against 60 to 90 per cent in the case of similar Institutions in U.K., Europe and America. Similarly, its activities cover only a fraction of its potential scope. The membership, at the end of August, 1949, was 5610 as against 2695 in 1945. The increase in membership has been 551 in 1946,658 in 1947,603 in 1948 and 1103during 1949. There has, no doubt, been a steady all round advance, more particularly during the last year, but the pace has been far too slow for this vast country. May I appeal to all qualified engineers in the country, who have so far not been associated with this Institution. to join it in large numbers and contribute towards its growth so that it can render more effective service to engineering and the country. The bye-laws of the Institution are being revised to provide more liberal opportunities for enrolement to membership with due regard to the need for keeping abreast of modern advance and changing needs of engineering.

The financial position of the Institution is now somewhat less gloomy. The Government of India have given a grant of Rs. 50,000/- during the year and a further grant of Rs. 30,000/- is expected. But for these, the Institution would have been faced with financial collapse. For the efficient discharge of its functions and responsibilities, the Institution must have adequate technical and ministerial staff, a comprehensive up-to-date library and a building to suit its essential needs. All this needs money. While contributions from the Centre and Provincial Governments may be forthcoming in times of crisis or for special needs. the main, if not the entire, funds must be raised by the Institution through increased membership. We must. therefore, continue to concentrate on the drive for membership started in 1948 by my predecessor-in-office, Sri N. K.

Mitra, and try our best to place the finances of the Institution on a sound and satisfactory basis. Requests are pouring in from various engineering colleges for the recognition of their degrees and diplomas for purposes of exemption from Sections A and B of our Associate Membership Examination. Before giving such recognition, the Council invariably arranges for a thorough inspection of the colleges concerned by specially appointed expert committees of the Council.

Our Institution has been increasingly approached to form expert subcommittees for the standardisation of materials and methods, and for economising in essential materials like steel.

The Federal Public Services Commission and the Provincial Public Services Commissions have recognised our Associate Membership Examination as an equivalent to Degrees in Engineering, Civil, Mechanical, Electrical, Mining, Metallurgy, etc. Big commercial concerns like the Bombay Electric Supply and Tramway Co. require all candidates for appointment to be Corporate Members of our Institution. In the Army young officers, if they reach the standard of Corporate Membership of this Institution, are given a qualifying pay of Rs. 75/- per month. Thus the standards of the Institution are accepted as a yardstick for assessing qualifications of candidates for recruitment and subsequent advancement.

During the year under review, there have been four events of importance in the international engineering field. The first was a meeting of the International Executive Council of the World Power Conference, held in Brussels in June, 1949. Sri P. R. Ahuja, M.I.E., represented the Institution at that meeting and ably assisted that Council in deciding the programme of and subjects for discussion at the Sectional Meeting of the World Power Conference to be held in New Delhi in January, 1951. As stated earlier, this meeting will be held simultaneously with the Plenary Sessions of the International Commission on Large Dams, International Association for Hydraulic Research and the International Commission on Irrigation. Arrangements for all these meetings and the exhibition are being jointly made by the Institution of Engineers and the Central Board of Irrigation (which are the National Committees for these international bodies) with the active co-operation of all related official and non-official organisations in the country. This will be the first occasion for holding the sectional and plenary meetings of International Engineering Organisations in India. We are expecting at these meetings nearly 400 top ranking engineers from all countries of the world and well over 200 papers. The success of these meetings and the Exhibition is a matter of National prestige. To make this occasion worthy of our best traditions in creative effort and hospitality, we shall need high class organisation, careful planning and considerable sums of money. It is my earnest hope that engineers, industrialists and others connected with development of the country will contribute liberally in money and personal service to make this occasion a grand success.

The three other International events of engineering importance were the Conference of the United Nations for Resource Conservation and Utilisation held at Lake Success, U.S.A. during August and September, 1949, a meeting of Experts at UNESCO House, Paris in July, 1949to discuss international co-operation in the field of engineering sciences, and a meeting of Expert Committee of UNESCO held in Paris in December, 1949 to consider the setting up of an Institute for Arid Zones. I had the privilege of attending the last two meetings but owing to my preoccupation in India I had to cancel my visit to U.S.A. in connection with the conference at Lake Success which was, however, attended by Sri Kanwar Sain, M.I.E. and other Indian scientists.

Development Plans and present Economic Situation.

I now come to the role of engineering in the new life of the country. We have won political freedom, economic freedom, has yet to be won. The speculative phase of post-war economy with its unrealistic planning based on the assumption that funds and materials would be available to any extent required is now over. The financial crisis of the last few months has brought us face to face with the hard realities of the situation. Funds are limited. Essential materials are in short supply. Technical personnel is inadequate under certain categories. The demands for these exceed availability.

What is then going to happen about our many development plans on the implementation of which our living standards were to be raised? There is no money and therefore there can be no development and because there is no development, there is going to be no additional money. Are we going to be caught in this vicious circle of no capital-no development and have nothing to offer to the common man but frustration?

I am an optimist. I refuse to take a dark view of the situation. The disappointments and disillusionments coming in the wake of the post-war boom have helped to bring in a sense of realism in planning and to focus attention on fundamentals, namely, the availability of resources and the essential needs of projects and on the necessity for allocating priorities with a view to taking up first things first. That in itself is a step forward towards achievement.

There is ample wealth in the country in the form of land, water and minerals and above all of human material. There is, however, an apparent shortage of money. But money is. nothing but the measure, as also the creation of human effort. The main problem is how to mobilise that effort for production and more production; to infuse into the general mass of people a sense of urgency in this respect and bring home to them the naked truth that unless we work and produce more, our present low standards of living are going to deteriorate still further and we shall be heading for an economic crisis. This is the task for which the Engineer is pre-eminently fitted.

Guides to Resource Conservation and Utilisation.

In his welcome address at the United Nations Scientific Conference on Conservation and Utilisation of Resources. Lake Success, New York, on August 17, 1949, Mr. J. A. Krug, Secretary of the Interior, Government of the United States of America, has given certain general guides to sound programme of Resource Development and Conservation, namely, that:

Most natural resources are inter-related and must be developed ai.d conserved together for maximum benefit;

Industry and resources must be developed simultaneously and in proper co-ordination;

Individuals must have equal responsibility with the State in abstaining from shortsighted practices in resources development and wasteful use of resources which may imperil the future of the nation;

The Government of the country as well as other nations of the world have a definite responsibility and duty in helping to develop undeveloped and under-developed areas;

There must be a proper institutional climate for resource development, namely, a feeling of confidence that the country is on the right track, that progress is being made, and that revolutionary changes which greatly affect the rights and equities of the people are not in prospect; a general understanding that wealth is created only by increasing production, and an incentive to investment, some of it in the form of risk capital;

It is necessary to have an inventory of resources and their periodical revaluation to keep them to date so as to find, for instance, what is on top of or under the soil and what power potential can be developed in the rivers.

Proposed statutory Planning Commission.

The Working Committee of the Congress has recommended the setting up of an overall Statutory Planning Commission with the following duties:

(1) To make a full assessment of the resources and the requirements of the nation.

(2) To determine priorities, to work out a proper allocation and distribution of the resources and their constant adjustment to the changing requirements with a view to obtaining the speediest and the maximum realization of the objectives of the plan.

(3) To lay down the various stages each covering a defined period. for the development of the country's economy and to undertake the necessary preparatory work in connection with each stage.

(4) To secure full and all round co-ordination in the process of planning and in the execution of the plan. In the context of the present needs and the circumstances of the country and in view of the economic difficulties which are being experienced, the Commission should devise immediate measures:

(a) to reduce to the minimum the dependence of the country on foreign sources in the matter of consumer goods, to bring about a speedy elimination of the import of luxury goods and such other articles as are not indispensable regardless of the inconvenience that may be felt by any section of the population;

(b) to secure the necessary capital goods for increasing the internal production of the needed articles as quickly as possible;

(c) to maximize the production of the essential primary goods, especially foodstuffs and raw materials for the principal industries, in the shortest possible time, and

(d) to speed up projects for increasing the irrigation facilities and power supply of the country which are the basis of its prosperity and progress.

Co-ordination and Priorities.

The preparation of an inventory of resources and the plans for their development, which will, necessarily be a continuing process, is in a large measure being already done by existing agencies. What is really needed is co-ordination and a determination of priorities to reconcile the competing claims of projects or parts of the same project, and of the various objectives in a project. This will include consideration of phasing and stage development of projects, with a view to achieve the maximum and quickest results within limits of available resources.

Stage Development.

The essence of stage development is that after the overall integrated plan has been prepared and accepted, its component units can be taken up for execution in the most profitable and expeditious manner, so that the benefits and revenues start accruing on one stage simultaneously with the undertaking of the next stage. Such a programme will help to keep the expenditure at each stage to the minimum, the accruing revenues will give substantial relief to the new expenditure involved in the next stage and the experience gained at each stage will be available for effecting improvements and economies in each successive stage and in the overall integrated plan. The common man will start seeing results almost side by side with the progress of expenditure instead of having to wait abnormally long till the completion of the entire plan. This is of the utmost importance in inspiring a feeling of confidence in the public mind in the efficacy and adequacy of plans. If achievement is delayed too long after the inauguration of a plan, the common man is apt to get impatient and lose faith in the will and capacity of the sponsoring authority to carry their plans to completion. This can have a most disturbing effect on the social and political atmosphere and act as an effective brake to public investment in new development schemes.

An example of stage development of one unit of a basinwide plan is the Kakrapara Project on the Tapi river in Bombay Province. This project is designed to irrigate annually about 6 lakhs of acres, generate over 200,000 kw of waterpower and provide flood control and navigation facilities. Due to financial and other limitations and top priority for good production, the irrigation part is being undertaken first, with power, flood control and navigation aspects to follow. But the construction of each stage is so arranged that each stage lends itself to superposition of the next stage without involving any wasteful expenditure or interruption or dislocation of the accrued benefits. The total expenditure on the project is estimated to be Rupees 28.5 crores, of which approximately 6, 3, 4, 8 and 7.5 crores respectively will be incurred in the successive stages. The time lag between each succeeding stage will be regulated by the availability of funds and the urgency of the resulting benefits venues will start coming in within a couple of years of start of the project and thus help in relieving pressure on financial resources for expenditure on the next stages.

Another example of stage development is closer at home in Bihar. It is the proposed Kosi Project. The project provides for the construction of a dam about 780 ft. above foundation rock (highest in the world), a power station with installed capacity of 1.8 million k.w. complete flood control of the Kosi basin, an annual irrigation of nearly 2.5 million acres and navigation facilities on the Kosi from the dam site to its junction with the Ganga. It is proposed to undertake this project in stages. Stage I will provide 5 lakhs acres of annnual irrigation in Bihar and Nepal, generation of 30,000 k.w. of power and partial flood control at a cost of Rs. 18 crores. This will also provide the essential preliminaries for the construction of the dam, namely, a railway line to the dam over the irrigation barrage across the Kosi at Chhatra, power for construction of the main dam, workshops, residential accommodation and other facilities. Stage II will provide additional irrigation making up, an annual acreage of 12 lakhs and increase the installed capacity of hydro-power to 90,000 k.w. The further, additional cost involved will be nearly Rs. 14 crores. Stage III will begin with the construction of the main dam which will cost Rs. 55 crores. This will provide complete flood and silt control and annual irrigation of 2.5 million acres. Stage IV will consist of installation of power units. The power units can be installed to suit the rate of load development and available additional finance. But under the scheme of stage development the immediate demand for money will be restricted to that required for the completion of the particular stage which has been taken up for construction. The delay in taking up the next stage will not interfere with the functioning of the first stage. In the interest of flood control, which is the major problem of the Kosi, it will, however, be desirable to complete all stages up to the completion of the idarn in as rapid succession as possible.

Phasing.

The phasing of projects and of the various stages of a project is of equal importance. By judicious phasing we can make our equipment, materials and technical manpower cover a much wider field of activity than would be the case if projects or parts of a project were undertaken in a haphazard fashion. For instance, construction equipment and specialised personnel after completing one dam can move to the construction of the next dam and bring to bear on it the full benefit of the experience gained on the first dam. In this way, the maximum use will be made of man and machinery and the mistakes and expenditure due to lack of experience or wrong choice of machinery will be minimised if not eliminated.

Realism in Planning.

I have dealt at some length with planning and the need for realism in the conception and implementation of plans. We have to make up for the inertia of decades under foreign rule. We are still in the stage of transition from a police state to a development stage. There is need for rapid development, but we have to regulate the pace to suit our limited resources in men, money and materials. We must utilise available resources to the best advantage taking up first things first and leaving non-essentials, however desirable otherwise, to wait for better times. With a realistic and firm approach we shall achieve results. If we disperse our resources and energy for any extraneous reasons, our efforts will gather only liabilities in the form of half finished undertakings and result in shaking public confidence in our ability to produce results.

Realistic planning must, however, ensure that industrial development will proceed side by side with resource development. For instance, it will be wasteful to produce large blocks of power without at the same time setting up the industry or other load to utilise that power; or to provide irrigation facilities without at the same time preparing the agricultural lands to receive that water.

As stated in the Working Committee's Resolution, projects for increasing the irrigation facilities and power supply of the country are the basis of its prosperity and progress and must therefore, rank first for priority.

In our impatience to cover in a few years toe track of a century and with an over emphasis on our limitations in technical know-how, we are apt to sit back and look up to foreign aid to produce results on our behalf. That will be an escapist approach. Foreign aid can be no substitute for self help. What use will it be if foreign specialists and foreign capital are dumped in the country when we are not ready to make full use of them. Foreign co-operation is desirable, even essential, if we are to get away from narrow nationalism and strive for the common advance of mankind. But we must seek this co-operation on a reciprocal basis and not in the form of a benevolent dole to a nation out of work or unwilling to work. It is for you engineers to show the way how self help can be integrated with international co-operation with best results and without impairing national dignity or sapping national will.

Engineers can Solve our Problems.

Referring to the present situation in the country, our beloved Prime Minister said at the inauguration on January 2nd, 1950, of the Indian Science Congress at Poona:

"Today unexpected pressure has come to bear upon us in the economic and other spheres with the result that we have to think entirely in terms of a rigid economy. All these difficulties have come when we thought of a vast number of schemes to raise the standard of living.

We are dominated by a lawyer's mentality and more lately by a classical philosopher's. Latest in the picture is the businessman's mentality. The lawyer still plays a fairly important part in our politics. But neither the lawyer nor the classical philosopher nor the businessman with his limited outlook can solve our problems. Only science can successfully be applied to solve the country's social and economic problems. I AM MORE AND MORE CONVINCED THAT THE TASKS CAN ONLY BE DONE BY SCIENTISTS AND ENGINEERS."

It is for you Engineers to accept the challenge and, in all earnestness. take to the task of solving the country's social and economic problems. It is a tremendous task, the fulfilment of which will need the total application of your special attributes of organisation, precise thinking, balanced sense of values, understanding of human psychology and above all tenacity of purpose in the achievement of the objective. I am sure, you will successfully undertake the noble task assigned to you by our beloved Prime Minister and win economic freedom for the Common Man.

Jai Hind.

Rai Bahadur Dr A N Khosla — a Brief Profile

Dr. A. N. Khosla (M.), Past-President, and Vice-Chancellor of the Roorkee University, has been nominated to the Rajya Sabha. Dr. Khosla was President for two consecutive years during 1948-50, and Chairman. of the Central India Centre during 1947-48

A reception was arranged by the Central India Centre at the Institution premises on Mathura Road, New Delhi, on April 23, 1958, to felicitate Dr. Khosla on the significant honour conferred on him by the nomination. The function was attended by Sardar Swaran Singh, Union Minister for Steel, Mines and Fuel, Shri Humayun Kabir, Union Minister for Scientific Research and Cultural Affairs, Shri Hafiz Mohammad Ibrahim, Union Minister for Irrigation and Power, Shri D. P. R. Cassad, President, and a large number of distinguished guests.

Dr. Khosla was born in 1892 in Jullundur. He graduated with Honours in Mathematics from the Dayan and Anglo-Vedic College, Lahore, in 1912, standing first in the University of Lahore.

He received his engineering education at the Thomason College of Engineering, Roorkee, taking his diploma in Civil Engineering in 1916, and winning many academic distinctions.

He joined the Punjab Irrigation Department in 1916. In 1918, he went on war service to Mesopotamia with the Mesopotamia Expeditionary Force, returning to Punjab in 1920. During the next twenty years, he served the Government of Punjab with great distinction which led to his appointment in 1943 as Chief Engineer and Secretary to Government, Irrigation Branch, Government of Punjab. During these years he contributed many original ideas to the design and construction of hydraulic structures, and his book on 'Design of Weirs on Permeable Foundations' has become a classic. It also gave Dr. Khosla international reputation as an engineer. The construction of the Panjnad Weir on the Chenab River and the reconstruction of the Khanki Weir were carried out on the basis of the new theory. He performed the unique feat of completing the construction of the Trimmu Weir on the Chenab in two years against the programmed period of five years, making the phenomenal saving of one crore of rupees out of an estimated cost of two and one-half crores of rupees.

He made many visits abroad to study the design and construction of large dams and multipurpose projects. In 1945, he was appointed Consulting Engineer to the Government of India and Chairman of the then Central Water Power, Irrigation and Navigation Commission, which organization came into being mainly through his efforts. Under his Chairmanship. this Commission became the vital and connecting factor in the development of river valley projects throughout the country. In addition to its role as a high powered planning and advisory body, the Commission has carried the responsibility of preparing designs and construction of major projects.

As Consulting Engineer to the Government of India Dr. Khosla solved the forty year Tungabhadra dispute between the States of Madras, Mysore and Hyderabad. In 1946, he attended the Executive Committee Meeting of the International Commission on Large Dams held in Paris, and was elected as one of the Vice-Presidents of this Commission. In 1948, he led the Indian delegation to the Plenary Session of the International Commission on Large Dams held in Sweden, and was elected Vice-President of the Commission for the second time. The same year, he was also elected Vice-President of the International Association of Hydraulic Structures Research. In 1950, he attended the Plenary Session of the Fourth World Power Conference in London, leading the Indian delegation, and was elected a Vice-President of the World Power Conference. In 1951, a Sectional Meeting of the World Power Conference was held in Delhi with outstanding success, under his *leadership.*

Shri Khosla was President of the Central Board of Irrigation and Power for three years in succession from 1946-48.

Upon his retirement from the Government of India in 1954, he was appointed Vice-Chancellor of the University of Roorkee, a post which he has filled with great distinction.

In recognition of his meritorious services, the President of India conferred on him the title of Padma Bhushan in 1954.

Shri K C Bakhle

B.Sc., (Engg.) (London), M.I.E., M. Inst. T.

Chief Commissioner of Railways

President 1950-51

Presidential Address

Your Highness, Your Excellency, Hon'ble Ministers, Ladies & Gentlemen:

My first duty is to thank Your Highness, on behalf of the Institution, for your gracious presence at this meeting. To have as our Chief Guest today the Rajpramukh of a State which has many engineering achievements to its credit, is indeed a high honour conferred upon the Institution. With your good wishes and blessings, Sir, we shall go ahead with the work of this Annual General Meeting, and take heart in tackling the business of the Institution in the year ahead.

I must next thank the Chief and other Ministers of the State who are also here today. That they should have found time despite their onerous duties to attend this meeting indicates their good will and interest in the Institution.

I suppose it is usual for the retiring- President, in handing over charge, to introduce his successor. I confess, however, that I was unaware, until I heard Mr. Khosla a few minutes ago, that I possessed all the qualities which he mentioned. It is as well that he did not, at the same time, catalogue my shortcomings. That must be because he does not know me well enough.

For the great honour which has been bestowed on me by my election as the President of this Institution, I must express my deep sense of appreciation. My experience so far in the management of the affairs of the Institution has been limited to serving on certain committees at Local Centres and for a brief period on the Council. I am conscious that the privilege of serving you entails heavy responsibility; following Mr. Khosla, who has so ably guided and controlled the Institution for the last two years, I will have to work very hard to maintain the standard set by my predecessor. I promise to do my best with your help.

I should like, next to refer to some of the more important domestic problems — domestic to the Institution. There is, as always, the question of growth in our corporate membership. Representing as it does all forms of engineering, the Institution needs to be helped by every means to attain in the public life of the nation that position of eminence which it deserves. Considering the total number of engineers in India who are entitled to become our corporate members, the present number of about 4,000 on our rolls is disappointing. The balance of the grant of Rs. 1 lakh from the Government of India has now been fully received; it is unlikely that we shall receive further grants of Government. The only way to improve the financial position and to place it on a sound footing is to double the corporate membership. This target can be easily reached if every qualified engineer joins our ranks and contributes his share to the benefit of the Institution. There are still, unfortunately, many who hesitate joining the Institution possibly because they see no immediate or future good to themselves by doing so. Institutions do not grow in stature if selfish motives remain a major consideration amongst men of the profession. Therefore, even at the risk of repeating what previous Presidents have said, I wish to appeal once again to all qualified engineers, who have so far kept out, to consider seriously whether it is not their duty to support us and help to make the Institution really worthy of India's greatness and status.

Pertinent to our efforts at increasing membership is the care which we must continually take to maintain quality. If the Institution is to claim recognition internationally — and that surely should be our objective — we must guard jealously the standards prescribed. Those who support an applicant must make it a point of honour to assure themselves that we admit into our ranks only such as are qualified to enter. As some of you are probably aware, the Council has under consideration the issue of a directive to all Centres indicating on general lines how to determine the suitability of a candidate for particular grades of corporate membership. Athough personal views may be different, I believe we agree that some measure of uniformity in making elections to Associate Membership and to full Membership with proper regard to applicants' qualifications, quality of experience and of proficiency, is extremely desirable. We have to remember that the letters A.M.I.E. (India) or M.I.E. (India) are hall marks of certain standards and these must not be lowered. May I therefore request that members pay particular attention to details on an applicant's form before they sign or initial applications, regarding this task not as a formality nor as a duty to be performed perfunctorily?

Another important problem is that of our Students. While we desire to encourage young men in their education towards qualifying for the profession, I think we will have to acknowledge that we have not so far paid adequate attention to the suitability of candidates who apply for studentship, to the manner in which they attempt to qualify for the profession or to the progress they make after enrolment as Students. These questions are all important and deserve special attention. I would suggest that Centres might consider evolving practical methods of sifting those suitable from others at the time of application, and later some system for the guidance of students in their work. We would thus be better able to assist the young engineer of the future and fulfil more satisfactorily one of our main functions.

A fundamental activity of the Institution is to disseminate knowledge of experience and of original research of its members collected from them by way of contribution of papers. This is how we add to the common stock of technical knowledge of the profession. You will agree that in comparison with this form of activity in and the standard attained by foreign institutions, our performance is not too satisfactory. It is certainly not the case that there is less material for papers or that there is less engineering talent in India. With the many engineering works, large and small, current in the various parts of the country, engineers are daily exercising their professional ingenuity towards resolving the particular problems which confront them, but only a few of them tell us about their experience. We must get more of our members to devote some of their time, despite their other onerous duties, to write papers and so contribute more freely to our Journal. Thus only can the Institution become a real live repository of the progress of engineering in India.

A difficulty of a serious nature with which many of our Centres are faced is that of suitable accommodation. They have made various attempts at collecting funds with which to acquire land and to construct buildings for the Centre, but their efforts so far have not produced the totals which they need to go ahead. Essential accommodation includes for every Centre, room for a good library, for its office and for an auditorium. Members have to a fair extent dipped their hands into their own pockets; there may be some who could spare a little more. Generally, however, we have to solicit help from outsiders, but it seems that the appeals made have not produced the response we need. It may be due to the value of the Institution not being fully recognised by people who can afford to give generous contributions. This, in -turn, may be due to engineers as professional men not being "publicity-minded". I would hesitate to suggest that we as a class should take a drum and beat it loudly in order to attract attention, but I would like to make an appeal to public-spirited persons all over India who have sympathies with the aims, objects and aspirations of the Institution to help us with funds as will enable us to find suitable homes for our Centres which stand in need. If this deficiency is overcome, we shall be able to do more intensive work for the good of the profession and in the service which engineers give to the public and State.

I would now like to mention the increasing part which the Institution has been taking in the international engineering field. A representative delegation of our members attended the Plenary Session of the Fourth World Power Conference in London in July, 1950, when my predecessor led the Indian delegation. The Sectional Meeting of the World Power Conference, for which the Institution, in conjunction with the Central Board of Irrigation, acted as the National Committee for India, has just ended in Mysore. This was the first occasion when India became the venue of Sectional and Plenary meetings of international engineering organisations, namely, the International Association for Hydraulic Research, the Congress on Large Dams, the World Power Conference, and the International Commission on Irrigation and Drainage. The success of these meetings just ended is a matter of national pride.

I must next turn to the second part of this address. In dealing with this, it has been customary for the President to discourse upon some particular aspect of engineering of which he has intimate knowledge. I do not propose to talk on any specific railway engineering subject, though perhaps I may take this opportunity of mentioning three major projects brought to fruition on Indian Railways in recent times: .namely, construction of the 142 mile metre gauge rail link to Assam; the establishment and opening of the Locomotive Manufacturing Workshops at Chittaranian; and completion of the work of widening of track centres on the Igatpuri and Lonavla Ghat sections of the G. I. P. Railway. In all these projects, the engineers had special problems, such as, well-sinking, bridging, town-planning, water supply, tunnelling, etc., to tackle and overcome within given target dates, and all this was done satisfactorily in spite of difficulties. It is a matter of particular gratification to us that the Chief Engineer in each case is a corporate member of the Institution. I hope that they will come forward with papers describing the works which they organised and carried through with such success, and I feel sure, that other members will find in those papers much, technical knowledge of interest.

Reverting to the second part, I confess to have found considerable difficulty in selecting a suitable subject. Ultimately I decided to consult a note-book, in which I jot down quotations, keep cuttings and occasionally record some of my thoughts. Out of these I have picked out certain ideas about which I propose, with your permission, to think aloud.

Since August, 1947 we have breathed independence, and we have felt happy that after all we are free to shape our destiny. Three and a half years have elapsed since that memorable day in 1947. Let us pause now for a few moments to see in retrospect the extent to which we as professional engineers have contributed to the improvement of conditions in the country, towards increasing the production potential, or towards making India more self-sufficientthan she was permitted to become prior to Independence Day.

Some progress has been made in the industrial field: with technical aid from those of experience, certain projects have been launched and workshops have started work with assembly of imported components. with set programmes of gradual expansion to the manufacture of the component parts until in a few years time, the product will be wholly made in India. Industry producing certain consumer goods has also increased capacity, production and sale. There is, however, considerable work still to be done.

Take, for example, just one part of a very essential aspect of our national life — the transport industry by rail, road or air. In plants which build rolling stock for railways, or motor cars and trucks for the road, or aeroplanes, builders in other countries lean with confidence upon a dozen or more indigenous ancillary industries for the supply of specialities. The builder of a motor car makes the engine and the chassis, he presses the bodywork and attaches that to the chassis, but he buys the electrical equipment, many of the fittings, components for the upholstery, the tyres and tubes, and even some parts which go to make up the engine, from firms who have specialised in the manufacture of those articles, firms which have established a reputation for the quality of their products. Neither the motor car builder, nor locomotive nor carriage building workshops fabricate all that goes into their products.

If one goes into details, one will find that quite apart from the needs of new production, India is extremely deficient in industries which manufacture the hundreds of components and fittings required for normal maintenance purposes. The use of imported goods thus becomes obligatory and if the annual cost of such imports could be calculated, I feel sure that the figure would stagger us. But, what, to my mind, is even more disconcerting is the unhappy experience and feeling among many That buying; "Indian" may often mean acceptance of lower standards of quality and durability.

Here is food for thought for us as engineers. In considering only one example, we have to admit that there is tremendous scope for original work to be done with the co-ordinated efforts of engineers on the consumer and production sides. For one large industry in a country, there have to be dozens and dozens of smaller industries, complementary to each other. developing manufacture of particular products of guaranteed quality of workmanship, precision and finish.

Turning now to the side of execution of works. whether these are being done on private account, or as part of the activities of a Governmental Department, are we engineers satisfied with the quality of the work produced under our charge? Let us next examine the role of the engineer in the planning and project stages. In certain quarters there is some hesitancy in accepting, at their face value, projects and plans as prepared by engineers. We are sometimes criticised for having a diehard mentality and for not being adaptable. Critics there will always be but! we must be certain on our side that in preparing a project or planning. its execution, our technical appreciation has not been coloured by extraneous factors. There are surely more ways than one of treating a project during its execution and opinions on this may vary in the light of the technical experience of different engineers, and we should with confidence trust the man on the spot, with his local knowledge, to do the best he can with due regard to efficiency and economy. This is as it should be but actually in practice this is not what always happens. There are cases where differences on technical fundamentals amongst engineers have given rise to some grounds for disbelieving either and our stock thereby suffers.

As an Institution, we are, and must remain, a non-political body. But that cannot prevent us from concerning ourselves with what is happening around us. The object and purpose for which the

Institution was constituted are to promote the general advancement of engineering and engineering science and, note this, to promote their application in India. It is therefore an essential part of our duty to look at the changed and changing circumstances, encourage steps taken in the right direction, also to take warning if we are going wrong and correct wrong trends before it becomes too late.

Engineering in its various forms is the basic industry on whose production of work and energy are founded the social and economic structure of the country. The process of building up the new India is bound to be somewhat slow, at any rate in the beginning. There are many among us who consider that the start has been much slower than we expected or desired. Doubtless there have often been circumstances outside the control of the engineer which have militated against more rapid progress. Perhaps, in certain directions, more is being attempted than we can really effectively undertake and it may be that enthusiasm, without a complete realisation of resources, material and financial, has misled some. However, no one can contend with the view that before a general economic recovery can take place, there has to be virtually a renaissance of engineering in India.

Now, what are the main ingredients which will bring about this renaissance? I would say, three: Material, Men, and Morale. Of the first ingredient, there is, or should be, no lack. Our country possesses many indigenous materials which can be used or which can be modified for our use. There are others which the engineer, with the aid of research, will be able to produce and we can add to these synthetic products as quickly as we develop our resources.

The second ingredient is men. In the shape of engineers we can face the present and the future with confidence. There is no dearth of talent or skill amongst our engineers. So long as the Institution ensures that college curricula provide for the teaching of the fundamental engineering sciences and we in the profession give to young qualified men the apportunities to acquire experience, India will have many able engineers to help her. On the score of technicians too, I think we are fortunately placed. The spirit of individual craftsmanship latent in the manual worker is still visible in the East and is not submerged to the extent that it might have become in more industrialised countries. I firmly believe that we can make good use of the talent amongst our workers provided they are given the necessary opportunities and incentives.

These considerations lead one to the question of man-management in an organisation. It is now universally acknowledged that goodwill as between the management and the staff is as important as goodwill between the management and the public, for ensuring success. The engineer, owing to the very nature of the duties he has to perform, is thrown much more into contact with his men and he should, I feel, be much more appreciative of the need to acquire and maintain goodwill than men in other walks of life. Man-management, however, is a subject for special study by the engineer in the field as well as by the engineer in the office.

The third ingredient is morale and though I have placed it last on the list, I regard it as being the most important. In the unsettled international conditions, when to prophesy the future is almost impossible, morale in the engineering industry, or for that matter in general life, is perhaps the most important faculty to acquire and to keep. History records cases where a General has, by raising the morale of his army, transformed it from one which had faced defeat into one which led on to victory with the same set of men and the same set of materials. Similarly, for the translation of political freedom into economic activity for the common good, there is great need of morale, without which there can be no initiative.

I suppose that a substantial proportion of the members of the Institution are employed in some Department or other of a State or Central Government. It is necessary for us to ask ourselves whether we are playing our part as technical men in these administrations with the boldness of conviction born of professional experience, or is there a tendency to play safe, to follow routine, to grope timidly through the new democratic environment with the object of self-preservation?

Are there among us any who, having no godfathers under the older regime, are now seeking, in some mysterious manner, influence and support from quarters where power vests? This way lie many dangers.

What the country and its Governments need in their services are technical professional men of integrity who are, capable of expressing their technical views without fear or hope of favour and who can be entrusted implicitly with the planning and execution of works of quality. In India, we in the public services and outside are facing problems in the newly formed democratic concept of Government which the older democracies in other countries have already solved. There, certain traditions have been established; here, the earlier traditions have disappeared and with those, I fear, also some of the better points of those traditions. New traditions are yet to be formed. The older amongst us have, indeed, a major responsibility to the profession and to our country in the forming of the new traditions of integrity and vitality as qualities of our community, qualities which have to be inherent and spontaneous throughout the engineering profession, emanating out of service given and not out of service extracted. We have to set the lead which the younger generation of engineers can follow of high moral fibre and character, of just and honourable dealing, shunning corruption, of which, may I add, the intellectual variety is the more insidious and dangerous.

High morale is really a way of life. It emerges from self-discipline and cannot be imposed by rules and regulations. It gives courage and satisfaction but it does involve the risk of receiving pain and discomfiture. The Institution's reputation depends almost entirely on that of its corporate members. When it is publicly recognised that a corporate member of the Institution, a chartered engineer, possessing technical acumen, is a person of inviolable character who can be trusted to say and act with truth and without bias, who has the vitality to overcome apathy, then indeed will the Institution begin to command attention in spheres where India's destiny is determined. I would like to end this address with a quotation from Mr. Chester Barnard, President of the Rockefeller Foundation. Referring to the U.S.A., he stated what he considered should be the qualities in the country's leaders for the maintenance of the American system of political and economic freedom. That quotation can with equal force be applied to engineers in India where economic freedom has yet to emerge out of political freedom. According to Mr. Barnard, leaders, and here I substitute for it the word "engineers", have to be strong enough to maintain their ambition under perplexities, patient to endure restraints, proud to be foremost among the free, humbly loyal to the humble, wise enough to seek service above illusions of power and futilities of fame, and willing to be briefly spent in the long span of marching events.

Shri M S Thirumale Iyengar

B.E., M.E.(Hons.), M.I.E., I.S.E.

President 1951-52

Presidential Address

Hon'ble Shri N. V. Gadgil. Your Excellencies, Ladies and Gentlemen.

It is first my very honoured privilege and pleasant duty to welcome you. Sir, the Minister for Works, Production and Supply, to this the 32nd Annual Session of the Institution of Engineers (India). We are grateful to you for accepting our invitation. As one of the creators of independent India. you are an engineer in a more comprehensive sense of the term (the word 'engineer' being derived from the Sanskrit root jan — जन to create). It is but appropriate that you should inaugurate the Session.

Next I wish to state that although I feel there are more worthy shoulders in this Institution that could have borne the burden of responsibility of this high office. I am nevertheless very proud of it and appreciate the graceful gesture of the Council in electing me as the President of the Institution. Partly, I take it, it is in recognition of my passionate longing for the brighter future. improved status and greater usefulness of our profession in our country. I promise I shall not spare myself in the cause of the Institution, and with a critically loyal and helpful Council and an efficient permanent staff and above all with the sympathy of the members, I trust that my one year's passing influence will be along the path of progress.

The Institution

The Institution of Engineers (India) has now completed 31 years of its existence. It has grown into a big organization with membership of all grades on its roll nearing the 8,000thmark.

When it was struggling to take shape in 1920, the public comment in the Press on what they called the 'engineers' movement' then was this:

'It is wholly a misfortune that engineers do not exercise a voice commensurate with their real status in the formidable socio-industrial problems which are today the main preoccupation of all civilized rulers and are likely to remain so till the end of our time. They ought to be the modest but valid and ever-ready mouthpiece of whatever is the greatest common measure of the social philosophy of engineers applied to current public problems. The man who has given us railways, steamships and telephones and makes six blades grow where only one grew before, deserves at least as much hearing as is claimed by lawyer, parsons, politicians and towncriers. He is certainly no less a public character than they.

India has special reason to take the engineer a little more to her bosom and right speedily. With a general industrial development impending, there is danger in neglecting to insure that the engineer is placed where he can be heard and heeded. It is not sufficient that the engineer should be an instrument; if the next generation is not to suffer, he must be an influence too.'

It looks as if this is as true today as it was then 30 years ago.

In years gone by, under the old administration, the Institution was expanding but slowly in its onward march to attain that stature and eminence that should characterize an Institution worthy of this great country. It has been functioning under a Royal Charter granted to it in 1935. After the independence, the complexion of the Institution necessarily has changed and the expansion is also rapid. The most important factor in the Institution's growth in recent years is the significant increase in the number of Corporate and Student members. The rapid increase of Student membership has resulted in the formation of Student chapters in some Centres. Almost all the leading engineers in the profession in India — both Governmental and non-Governmental — have come into the Institution's fold. The Institution has therefore a great responsibility now not only to the profession as a whole, but also to its own membership. The steady growth in membership in the past few years has been gratifying not only because it has aided in some way the finances of the Institution, but particularly because of its raising or employing the Institution 'potential' for more intensive work, and enjoyment of the fruits of the technical work by a wider circle. A larger membership is thus indicative of expanding interest in the Institution's activities.

Almost following its birth in 1920, which incidentally happened at Madras where I come from, this Institution established Local Centres in different parts of the country. The cooperative effort of our Local Centres is the underlying basis for the Institution's accomplishments, and these are in turn fundamental in procuring new members. And this step has been serving to encourage engineering education in many forms. The Council of the Institution specially watches that the training of young engineers in the various engineering colleges in India, whose degrees are accepted by the Institution, is sound. And when students join the Institution, they are given special opportunities for listening to technical papers, to take part in discussions, and to visit works in progress. This is the system on which the Institution works in all its Local Centres throughout India. Thus the organization keeps careful watch on the working of various engineering colleges and institutes, and before it acknowledges their degrees it satisfies itself that their standard of education qualifies their graduates for Corporate Membership of the Institution.

The Institution also insists on a very high standard for its own examinations. The Union Public Service Commission has adopted these standards as a qualification for admission of engineers to public service.

The Institution welcomes to membership fully qualified engineers without distinction of nationality, caste or creed and the standard demanded for Corporate Membership of the

Institution is recognized by the Government of India and the State Governments in the making of appointments to public services.

The Institution has embraced all the branches of engineering — Civil, Mechanical, Electrical and Chemical — and this common Institution is able to render better service in fostering greater cooperation between the engineers of the various branches. And no less important is the fact that the technical personnel in the three Defence Services, in whose hands our existence as an independent sovereign nation lies, are conscious of the importance and influence of the Institution. This is amply borne out by the fact that the engineers in those services, under the leadership of their Engineer-in-Chief, have been taking a keen interest in the affairs of the Institution. And I am confident they will continue to identify themselves with the Institution in an ever increasing measure with the march of time.

The Institution publishes a technical Journal quarterly, and has started publishing a quarterly Bulletin. I expect very soon the technical Journal will issue monthly in view of the large number of technical papers read and discussed at the Local Centres, and also the need for publishing notes and data relating to the work of research organizations in this country and abroad.

The many-sided activities have also made it possible for the Institution to be represented in the various committees set up by Governments and other bodies-not to mention of representation in the governing bodies of the various engineering educational institutions in the country. The Institution also acts as the National Committee for the World Power Conference.

Thus the Institution is now definitely establishing itself as the acknowledged authority in engineering matters in this country and the guardian of sound engineering traditions.

In the light of these facts it cannot be denied that the Institution richly deserves help and encouragement from the Central and State Governments; but its future progress will be highly facilitated, and its standing considerably raised nationally and internationally, if it is given a suitable statutory status on the surrender of its Royal Charter. The Government of India have been approached to incorporate the Institution by an Act of Parliament, and on behalf of the Institution I appeal to the Government of India' to undertake and enact the necessary legislation as early as possible.

Engineering profession

While the Institution has made efforts to live up to its responsibility to the profession as a whole, it is faced now with new and active problems created by the growing importance of the engineering profession in the national economy.

In speaking to members of the Institution in this connection, it is hardly necessary for me to stress the advantages to the profession of cultivating good fellowship. The International Engineering Conferences in January 1951 at Delhi and the study tours connected therewith, at all of which there was a happy 'mix-up' of the Indian and the foreign engineers, have taught us some valuable lessons. In that contact, most of you perhaps are aware that there was manifestation of abundant good feeling and broad-mindedness by the foreign engineers. This is worthy of emulation. This is the one profession, perhaps, where there should be little or no impact of political, geographical or racial discrimination in so far as the dissemination of engineering knowledge goes. We must develop in fullness, friendly feelings, broad-mindedness and a thoroughly wider outlook amongst ourselves to enable us to give our best to the country, which now so badly needs the coordinated efforts of everybody.

I am emphasizing this aspect because isolationism tends to suppress the manifestation of good feeling and good fellowship. Whether a man will treat his professional brethren in a gentlemanly way or in an illiberal spirit is partly a matter of temperament and partly a matter of training. But it is for the senior members of the Institution to set up traditions that will once for all establish training on right liberal lines. My advice to the junior engineers is that they should not sacrifice mental independence in service. And the seniors ought to consider guarding this mental independence of juniors a sacred trust. They should not adopt an altogether paternal attitude, but should be fraternal according to the spirit of the times.

Talking of good fellowship you must have an honest heart. I say advisedly 'honest heart' because the honest head is prone to be cold and stern, given to harsh judgment and not anxious to put the best possible interpretation on the motives of a fellow worker. The members of the Institution therefore must rise above all prejudices and put their heads together to solve problems or to examine schemes wherever it is necessary and important in the national interests. Then only will we be able to do substantial service to this country.

This has also a direct bearing on the growth of the consultant class of engineers and firms under the aegis of eminent engineers. Not only such a class will conduce to the adequate training of young engineers, but will also help the great need for mobilizing all talent and past experience to examine our development schemes. The most important first practical step to encourage this growth of the consultant class of engineers is to go ahead with the 'Registration of Engineers' in the country. The bill contemplated for this is under consideration by the Government of India, and I trust it will be enacted as early as possible-the sooner the better in the interest of the country's development on sound, quick and safe lines.

It is needless for me to say that Government should take advantage of the Institution to refer all their big projects for opinion. And it shall be the duty of the Institution to constitute that panel of eminent engineers who will place their services at the disposal of the Institution and the country.

Engineering education

In India, from the earliest times, the engineer has played a very important part. He has done considerable work in the way of irrigation. drainage and reclamation of land, apart from the mluvellous building technique which is seen in the great monuments of old that are still preserved to us for our benefit. One cannot fail to be struck with these immense monuments-built in ancient times by the Hindu Rulers. That was the work of civil engineers in ancient times when large-scale use of machinery was either absent or there was none at all. Mechanization did not develop because of the availability of huge manpower and other resources considered limitless then. Phenomenally low prices also obtained. In modem times the cost of living has been going up. Man's needs for comforts have expanded. Labourers, wages have gone up, and the output per man-hour has deteriorated. To make up for some of all this loss in production and efficiency, the mechanical engineer has cometo the forefront, and devised mechanical equipment for many types of work.

Take the case of execution of a large irrigation project. We have mechanical equipment for transport of materials, for drilling and grouting of foundations, for grinding of mortars, workshops for repairing the equipment and for manufacture and fabrication of steel structures like gates, centerings for gallery and innumerable other small mechanical jobs, and many of these run by electric motive power. While specialists may be engaged to be in charge of the various branches of engineering activity, nevertheless, the chief construction engineer of the project must have the basic knowledge of the other main branches for complete coordination and harmonizing the construction operations for maximum efficiency and benefit.

Really whatever branch of engineering it is, all of our work is based on the same fundamental natural laws, and all of it demands the same logical approach. The type of approach to the design of a bridge is the same for the design of a spillway gate, or of an organization, or of any kind of set-up.

Modern engineering education, therefore, must cover this aspect to enable the young engineer to tackle the execution of works with some confidence.

The aim and educational policy of the Institution of Engineers should be the production of this 'practical' engineer. to surround the young maturing engineer with the best and highest estimate of what engineers are capable of, so that he may always regard himself in the impersonal light of a great tradition of engineering achievements.

In the selection of a theme for my address I was quite undecided for a long time until the very last. Many distinguished Past-Presidents have spoken generally on subjects to which they had devoted considerable years of their professional career, or on subjects in any special field of engineering where they were recognized as authorities. In my own case, I have for the last 30 years been engaged on various phases of public works, not excluding teaching. I was for a short while, early in my professional career, a Professor in Mechanical Engineering at the Engineering College, Guindy, Madras. But for many years, I have been engaged on civil engineering work comprising of large investigations and constructions specially of irrigation projects.

We have been having strong verbal doses of this or that benefit that accrues out of the multipurpose projects from the Himalayas to Cape Comorin. The Planning Commission has been endeavouring to give their best attention to help getting through some of them that are likely to yield quick results in the matter of food production We have some large schemes under execution, which when completed will give some benefit by way of increase in food production and power. But we want enormous additional food to be produced. For this, we have vast natural resources awaiting development. What they are and how they have to be developed, we have been told many a time. I do not propose to repeat the off-repeated, though it is necessary under certain circumstances that matters require to be continually flashed before our minds in order that they are not lost sight of. I also do not propose to deal with any irrigation or irrigation projects and not even the Tungabhadra Project most familiar to me just now. A considerable amount of literature has been published regarding all these. Suffice it to say that in the present context of things, engineers engaged on the execution of projects are the pioneers in the development of independent India and on the engineers as a whole, and on those engaged on the irrigation and power projects in particular, hangs the salvation of the country.

Enough has been said of our ancient civilization and glory, when every kind of craft, business and industry thrived, not to speak of engineering skill and technique in construction of irrigation works as well as buildings of art and beauty-many monuments stand today over a thousand years old from which we can derive inspiration.

But the ancient traditional way of doing things for carrying out our huge multipurpose projects is very much out of place in many cases. As I already said we can only draw the inspiration from them and imbibe the spirit underlying the methods, or the spirit of steadfastness and perseverance of those days in achieving great deeds of skill and prowess. The main supplement to carrying out our present gigantic schemes is research on building materials for economy; and research into the expeditious means or methods of execution of works. Our progress in engineering should not consist in mere imitation of the West, simply following the logical sequence from where we are, which means lagging behind at a safe distance for ever. We can tolerate imitation when inevitable, but should not perpetually exult in it. It can easily prove fatal to progress. We should not also adopt foreign standards blindly.

But we cannot go slow. We must go fast even to keep within sight the self-sufficiency goal. 'Self-sufficiency' can be approached only if we complete all our projects as targetted for, and increase the yield by 25% on the 40 odd millions of existing food producing land.

It is difficult to attain the self-sufficiency state with the present uncontrolled population increase trends. Our salvation would seem to lie to a certain extent in family planning. But this family planning may not succeed with the agricultural labour as they generally believe in having a large family to work in their fields.

Substitution of manual labour by small-scale mechanized equipment in agricultural operations will reduce the drudgery and limitations of land operations. That will in turn reduce the need for having a large family to work on the farms or in the fields. So let us take steps to mechanize the village peoples' operations by small equipment within the means of the villagers. Let us manufacture such in our own country by extensive 'spread out' cottage or small-scale industries.

Things no doubt look gloomy. Remember the five-year plans and twenty-year plans of other countries have had a fair amount of success because nature's benefits were shared by a fewer number. What I mean to say is this. In the Soviet Union the average population was 23 per sq. mile. In the U.S.A. it was about 40 per sq. mile. In India it is about 240 per sq. mile.

It is obvious that other things being equal, amenities should be inversely proportionate to the density of population. If our technical advance was at the same level as that of the U.S.A. even then our standard will be only one-sixth that of the U.S.A. This basic fact should be kept in view in framing our laws. Too much emphasis on increase of living standards may tend in some cases to a deterioration of moral standards. Perhaps we would do well to ask the rich and the high-placed to lead lives of austerity rather than preach higher standards to the lower classes. That is why 'Mahatma' started with the loin cloth as one standing face to face with truth—past, present and future. Austerity, I suggest for the time being, as a springboard for greater production.

Of course, minimum standards are essential for food, clothing and housing. While food standards should be the same for all countries, clothing and housing should be suited to climatic conditions. We engineers have to solve the housing problem as well.

In the West, countries like England with a small area and dense population had to look for food in other regions. With chalk and iron ore, they started their manufactures, and very soon offered manufactured products to outside countries for food in return.

Our salvation therefore lies in not merely expanding the food producing land, but really in industrialization and mechanization. Mechanized methods will open the eyes of the agricultural worker also to family planning when he sees he no longer requires a large family to get through his work. But successful mechanization depends on industries. We cannot go far if we are to get every pin, bolt and nut from other countries. We must manufacture our mechanical equipment and gadgets in our country.

The greatest factor in the development of a country for manufactures is undoubtedly the application of mechanical engineering, which is essentially the utilization of power or the energy from the forces of nature through mechanical devices.

England produced Watt and Stephenson who inspired the mechanically minded engineers and scientists to continue the work and perfect their inventions. They were the pioneers of the 18th century. The 19th century saw the development of the science of thermodynamics and the development of internal combustion engines the Diesel engine. The greatest advance in steam power was in the second half of the 19th century, when Parsons invented the steam turbine. This was immediately followed by scientists in America, France and other countries perfecting the steam turbine. And that made it possible to generate electricity in central power stations. And even today the thermal stations have come to stay.

A manufacturing country like England had necessarily to look to advances in mechanical engineering, and the advances also have been made possible because of metallurgists like Bessemer and Siemens who invented the methods of making steel. These pioneers of the 19th century were responsible for the great strides made in mechanical engineering advance. They taught how to produce the steel which had vast strength and durability, which, with further research into its structure, gave alloy steels, used with great advantage for all structural works, rails and several other constructions including ships. The 20th century wars have given such an impetus to scientific research (that could not be foreseen in the 19th century) that things are moving very fast and the inventions of yesterday are discarded in favour of inventions of today. Indeed, science is unfolding the hidden secrets of nature very fast. I will not be surprised if even in my generation people yet see the 'atom' rendering obsolete all the achievements of the past hundred years. It appears 'the new steel works at Fort Talbot (Glamorgan) turns out 4,000 tons of steel faster and better than anything else this side of Pittsburgh. Everything should work at the touch of a button and out should come steel sheets by the mile at 25 m.p.h.—it is a $4^1/_2$ mile long plant.'

That is what is happening today in those countries where you have the inspiration of ages to make the people mechanically minded, and who had to develop in that manner to retain the supremacy in manufacture of goods that are in great demand, and goods that cater to the needs of civilization-a civilization that sometimes unfortunately puts greater belief in armaments to maintain peace.

But India which is an agricultural country did not think in ancient times that civilization meant the production of mechanical equipment and adoption of mechanization. On the other hand the development was on the cultural and spiritual plane. Our philosophy also developed when the material civilization was highest. This was made possible because of sufficiency in food, low cost of living, and adequate minimum comfort needs. But this country with abundant culture and philosophy can no longer remain merely agricultural, but has to become a manufacturing country if it is to survive. We must attain self-sufficiency largely by our own efforts with as little outside help as possible. We have to increase the agricultural areas for food, and the process has to be quick, and this can be quick only if we have mechanical equipment for mechanizing part of our agriculture and part of our multipurpose project execution. As I have already emphasized, it is only a manufacturing country that can successfully tackle the problem of mechanization. Obtaining the mechanical equipment and machine tools from abroad should be only for a very short time. We must develop our heavy industries and start medium scale industries to make it possible for us to manufacture much of the essential equipment like tractors, earth excavators and earth movers. But without a mechanically minded people and atmosphere, we cannot progress in this direction.

We engineers in India have been at a great disadvantage. Due to our low living standards and lack of industrial development or industrial life, and the unsuitable system or kind of education imparted to us in the early schooling years, most of us did not have any opportunity when young to gain some practical knowledge about engineering. Almost as a rule, you are aware that the young boys are interested in automobiles, railway engines and machinery. They exhibit considerable curiosity, inquisitiveness and interest in trying to find out all about them. But all that interest, curiosity and inquisitiveness could easily be turned to useful and practical ways, if facilities were there to learn more about them in a practical way. If we gave our boys some small tools and rigged up a small workshop, being young and impressionable the boy gets a practical bias by working at these tools and becomes mechanically minded. We must therefore make the younger generation mechanically minded—the school children. It is only then that out of them will come out a Watt, a Parsons or a Kelvin.

Institutes of technology like those at Chromepet or Kharagpur, which teach electronics and aeronautical engineering besides other specialized subjects, are springing up in various parts of the country, but these at best may produce a mechanical engineer who will operate the machine but cannot make an inventive genius of one who has not got it in his blood.

The latent faculty will show itself early in boys and from that age it should be developed to produce results. So it is at the early age that we must try to pick out the future inventor and mechanical genius and such a one can be picked up only from a vast number. So make the vast number at an early age mechanically minded. Re-orient the education in schools, and encourage and provide facilities for development of that faculty if it exists in a boy, irrespective of his caste or creed or station in life. That seems to be the only way to catch up the mechanical engineering advance in a reasonable time and pave the ground for mass production of essential goods, *News Record* of March 1951. which gives the impressions and opinion of the United States' leading engineers who saw the Tungabhadra Dam construction operations in January 1951, amply bears out my earlier observations.

'Although most current dam thinking in India is centered on concrete or earth section, one of the most interesting structures (and the best organized from a construction standpoint) is of stone masonry. This is the Tungabhadra Dam on a tributary of the Kistna River. Built primarily for irrigation, it will also provide incidental hydro-power.

Tungabhadra Dam will be one of the largest masonry darns ever built. Although not as high as Mettur (160 ft.) it is 8,000 ft. long and entirely of hand-placed stone, The volume of stone alone, exclusive of mortar, is 1.2 million c. yd.; probably 60 million separate stones will have to be placed before the darn is complete.'

In almost all cases of the large dams and reservoirs entrusted to foreign engineering firms and consultants for designs, you will find on examination that practically all the work has been done by our boys and engineers deputed to work at the foreign agency 'bureaus'. I think we have been going a little too far in this business of foreign consultations, with the result we are not gaining the object of quick production.

We must remember that identical circumstances will not exist as between different countries I but circumstances as nearly approaching to similar conditions may exist in some cases. So we must adapt all that we learn from outside examples, suitably modified to local conditions. And that is the only way to obtain maximum economy and expedition. Our aim should be to study in foreign countries the organizational methods, operational methods, and various other matters of technical 'know-how', always keeping in mind how such methods can be adapted, modified or improved upon so as to be suitable to the existing Indian conditions. What exactly has been the benefit that has accrued in sending so many engineers abroad for training and study? Many of them seem to have more enthusiasm for the other countries than for their own.

We must send for foreign training men with stout hearts and not those with craven spirits. Those who study-toured in the foreign countries with a flair for research and designs have really been doing useful work. Even in the matter of designs, the search for novel designs or adoption of new ideas prevalent on the Continent and elsewhere may cause delay in execution of projects. A two- or three-year delay in starting a project on account of periodical revision of designs to save a small and inappreciable amount in schemes costing several crores, postpones completion of the project by those two or three years, thereby losing several crores of rupees by way of food imports not commensurate with the initial small saving. Where we are aiming at quick results, we must take quick decisions. Otherwise the benefit will not be near at hand.

So I say, let us engineers put a stop to vacillation, delay and postponement and do something quick. Remember the words of our Prime Minister Panditji. 'Success comes to those who dare and act, it seldom goes to the timid'. Remember our philosophy is philosophy of action and not talk. Let us leave the talking to others that must necessarily talk to justify their profession. But engineers must do कुरु and that is the teaching of the Gita. which. as I have already mentioned. is the quintessence of our tradition. culture and philosophy. Next I should like to say a word about research.

Research

Recently I had occasion to read an article on 'How Germany Did It' by Prof. Adams of the U.S.A.

He has given the reasons therein how Germany rose to the position of a leader in the basic sciences in the whole world and how Germany did accomplish in one or two decades more in the matter of fundamental developments than all other nations put together. He says that Germany had professors who were geniuses in fundamental research and that they were provided with unexcelled laboratories.

These professors were so influential in the life of the State that they were respected by industry, the Government and the public. They were considered a vital factor in the progress of the German nation and they had a social standing permitting them privileges not accorded to others.

It appears the professors were second only to the military and above the politicians in social prestige. Yet they did relatively few things socially. They were exceedingly hard workers. They worked all the time; they had extraordinary memories with a tremendous fund of coordinated information for use in whatever problems they were tackling.

The popular saying in India is 'Discourage a student from memorising: just advise him to learn principles'; principles are important but unless a multitude of facts are available a scientist will not be original or be a creator of new principles. Every talented man or genius was one who had a prodigious memory; who had available a storehouse of facts which he could use in original works in the creation of new ideas and new theories.

What we lack in India is a system by which the talented can be found and given the opportunity for rapid progress as compared with the great mass of the average students. Our system of education may be superior for training men for average positions in Government and private organizations. What we lack is the means to find out those persons who fall into the rare class of the 'very talented', of whom we seem to have so relatively few in India. I am not sure if we have really the will to find the man of strong propensity for the subject. We must rise above all prejudices and select the person. Once selected he must be given the status and position that places him above the common people.

Only a few have the drive, interest, ambition, proper outlook and enthusiasm for acquiring the broad knowledge of the fundamentals which for the most part must be only self acquired. A man cannot acquire by study the ability to be a genius or to be talented. This is an innate trait which can be greatly developed by proper training. We must therefore find a means for selection of the very talented and offer them special opportunities. We need a system first for screening our scientists and other talented men, and, second, for giving to those who show a germ of genius facilities and conditions for self development.

If we had a reservoir of such talented individuals from which to appoint instructors, professors and research workers, and, last but not the least, to man our great national laboratories, the future of our nation would be a materially improved one. Specially. we must get the research man who can see the important problems to be solved and who at the same time is never discouraged and persists until each is solved in the laboratory and on the field. We must man our key laboratories and institutions in this manner. The reason why I have emphasized the research in pure sciences is this. The present remarkable position in applied science and engineering trades of all sorts is purely due to pioneering research work in pure mathematics. physics and chemistry. Also there must be engineering research units in the National Physical and Chemical Laboratories.

Then we have the housing problem which requires some intensive research on materials. While there has been a great impetus given to research in irrigation matters largely, and the several experimental stations throughout India have taken up intensive work on model experiments and research connected with dams and spillways, etc, we do not seem to have made any headway in the matter of building research. Our housing problem has been one of the most acute and is no less important than the food problem. The problem of producing cheap houses has been and is being investigated in many States in this country, but the fundamental approach to the problem seems to have been not on quite the required lines. We have to use the locally available materials rendered cheap, durable, fire-proof and readily usable. If we only remember that the agricultural labour and the cultivators — many of them live in mud-walledhouses roofed, with inflammable thatch and such material — we will readily understand our problem of cheap housing is to make the earth for the walls more durable. less erodible and better preserved and the roofing materials fire-proof. Intensive research into this. I am sure, will yield favourable results that will at once solve the problem of cheap houses for workers and the poorer sections of the people.

In the field of engineering research, to solve irrigation problems and designs of irrigation works. some advance has been made in the country. A number of research stations have been established in different parts of the country; some conducting experiments on the strength and behaviour of materials, proportioning and grading of concrete, some solely engaged in the analysis and study of soils. and some on scale models of irrigation works where the flow conditions are simulated and valuable data collected resulting in the efficient and economic design of the prototypes. The notable contributions these research stations have made are in the matter of designs of dams, spillways for overflow dams. energy dissipating arrangements below the structures and problems relating to uplift. scour and various features relating to canals. The Tungabhadra Dam designs were fully experimented on and tested at the Poondi Research Station in the Madras State. Designs in connection with the Ramapadasagar and Krishna-Penner Dams and works have been experimented extensively at this Research Station and at the Concrete and Soil Mechanics Laboratories at Madras before they were finalized. Some of the dams to be built in North India. designed in foreign countries and experimented on in a few cases there, are being tested in the Research Stations in the Punjab and Poona before adoption. India leads in irrigation and I dare say the day will not be far off when she will have the pride of place in hydraulic research too.

We have also made considerable advance in the study of mortars and their use in dam construction. In all our ancient works surki mortar has generally been used. The dams across the Periyar in Madras — Travancore, the Vedavati at Marikanave, and the Cauvery at Kannambadi in Mysore have all been constructed in lime-surki mortar. Cement gradually supplanted the lime-surki. Cement manufacture was established in this country. We are getting now practically all our- cement from our own factories here. This supplanting of lime and surki by cement was in a large measure due to the fact that cement permitted quicker execution. But the use of cement in large irrigation structures has some drawbacks and this is now sought to be remedied by mixing it with is what called a 'puzzolana'. Puzzolana is strictly a volcanic ash found near Pozzuoli in Italy, much used for making hydraulic cement. It is possible puzzolana was used to a large extent in the construction of the Roman aqueducts to carry drinking water to the city of Rome. The term gradually lost its local significance and today any admixture which increases the hydraulicity of fat lime goes by the name of 'puzzolana'. The surki — which is only plain brick powder — so largely used in this country from a very long time, is an efficient puzzolanic material. Being a scientific age we have now established by research and experiments that the mortar with an admixture of surki is very much better than one of pure cement. This cement-surki mortar — or 'red cement' mortar as it was originally called at Mettur — which retains practically the same strength is flexible, workable, impermeable and obviates the need for elaborate cooling arrangements to dissipate, the large heat of hydration inherent in massive dams built entirely of cement. Another advantage in the use of this puzzolana is that it readily combines with the free lime liberated in the setting of cement and avoids the disintegrating effect of free lime. From the experience gained with the old lime-surki mortars and the red cement mortar at Mettur, one feels that there is no reason to question its durability as well. And on top of all this, in large structures the saving in cost on account of its substitution for part of cement is something appreciable. At Mettur the replacement of one-fourth of the cement by surki resulted in a saving of about fifteen lakhs of rupees. In the Tungabhadra Dam the use of lime-surki mortar for the bulkhead sections and cement-surki mortar for the spillway and sluice locations in lieu of pure cement mortar has resulted in a saving of several lakhs of rupees.

Extensive research has also been made at all research stations and laboratories in the country on soils. We have not been slow in taking advantage of the recent rapid strides in the science of soil mechanics. The day when earth dams of over 50 or 60 ft. in height were viewed with fear is gone. We are now building high earth dams. There is one under construction in Madras and another in Bombay. This advance in soil mechanics has saved us considerable money in earth dam structures—as much as 35 to 40% as compared to masonry structures.

Research work on soils has produced excellent results in another phase of construction, viz., roads. Soil-stabilized bases for road structures in lieu of the Telford base have proved very much cheaper while satisfying the required strength and bearing pressures even under very heavy loads. In the delta areas where stone is rare or is obtainable only with long leads, a soil-stabilized base is the best and most economical solution. Several hundreds of miles of such roads have been programmed to be laid in the Madras State and are now in progress. The total saving in cost by the use of this is expected to be in the region of crores of rupees.

Though on the civil engineering field we could hold our own with the rest of the world, the progress of research on the mechanical and electrical engineering field has not been appreciable, mainly because of our not being a manufacturing country. The wide range of hoisting equipment, and spillway and high head gates offered by the firms in the West and on the Continent opens our eyes to the extensive research work done in these countries regarding these steel and metal structures. The difficulties I have been experiencing in the manufacture of these gates and equipment for the Tungabhadra Dam at the site make me wonder when we will ever compete with foreign manufacture in the matter of variegated designs, production and delivery. Machine tools for the gate manufacture at Tungabhadra Dam had to be obtained from the German reparation machine dumps under high priority given by the Government of India. To progress in mechanical engineering we must have machine tools; and the establishment of machine tool industry in India must be expedited as it is the first step towards our becoming a manufacturing country.

Library

The various Centres in India should take steps to establish and develop libraries that should contain the latest books on engineering. It is needless for me to mention that it is the library that gives us a start in life. It is the library that keeps us in touch with modern and the latest trends. In the words of a great professor. 'A library is a great catalyser, accelerating the nutrition and rate of progress in a profession.' And a library is important for research. The great men live in books. We must hasten the day when we shall see the library shelves partly filled at least with authoritative technical literature written by our own eminent engineers. We, as a race, lack the habit of systematic recording which afterwards automatically develops into a book. I believe we are changing for the better in this respect in recent years. We must encourage writing books on building materials and construction in regional languages that will be understood not only by the supervisory staff but at the labourer's or worker's level. That is the start that we have to make, to enable the highly technical books, journals and research publications to be written in those languages in years to come. It is bound to be only a, gradual development in view of the need to coin new words and to select the correct words from ancient Sanskrit and other texts. Also the engineering books must first be written in Hindi and they must be translated into the regional languages from them. When I see a genius (a man with a strong propensity of nature) of a builder, mechanic, carpenter or craftsman — perhaps a descendant of the 'sthapathi' of the

Madura temple or the master-builder of the Taj Mahal—I feel the tragedy of the appalling waste of indigenous engineering talent, simply because of the bar of a foreign language which keeps the modern engineering science a closed book to him. I strongly appeal to the members of our profession to give their help to advance these cherished purposes. The Madras Centre has approached the Government of Madras for a grant for its library and it is likely that Government will give a handsome contribution. The States and Central Governments I trust will liberally help the Institution in this matter.

Conclusion

I think I have rambled enough. Let me hasten to conclude. To the young engineer I shall say that the profession which he enters today secures him an useful life. Of no other profession can this be said with greater assurance. Let him remember the construction activities with which all are familiar — the building of dams, bridges, roads, irrigation canals, hydro-electric works, etc. These are all the many things of today and the future. These are bound to grow and expand in the search for solving the food problem. To each one of you the practice of your profession will be very much as you make it, either a worry, a care, a perpetual annoyance, or a daily joy and a life of happiness and usefulness. We must try and make it the latter. Next I would exhort the senior engineers, and particularly those who have retired, to take a special interest in the Institution. Especially, when the country lacks adequate technical personnel, engineers who are proverbially known to keep better health than members of other professions because -of their outdoor executive life must continue to work till an advanced age. There is the classical example of Sir M. Visveswaraya who past 90 is still keeping aloft the lighted torch of engineering. The country and its leaders expect us to help them in solving the nation' s problems. If we would only rise to the occasion. lead dedicated lives and fulfil in some measure what is demanded of us in the crisis which the country is passing through. our profession would go down in history as the saviours of our Motherland. A dedicated life would mean that you should not only concentrate all your attention and energies on being a successful practical engineer but that you should also never cease to be a student. Never should we forget what Plato has said, that education is a lite-long process, in which the student can only make a beginning during his college course. What matters is the relish for knowledge which puts life both into the student and the professional engineer and which ultimately makes the engineering schemes and science in the country throb with life. Another important point to which I would like to draw your attention is that while engineering is our vocation. we must cultivate an interest in literature and the humanities. so that we, may have a hobby or intellectual pastime other than that relating to our profession, and to which we may turn to in times of worry. When you are too worried with any engineering problem, turn to Valmiki, Kalidasa or Shakespeare. Success in life depends as much on the man as the engineer in you. Our goal is the attainment of a welfare state in the most comprehensive sense of the term. It behoves us, engineers, on whom the brunt of the responsibility naturally falls, to gird up our loins and equip ourselves to fulfil the task, and attain that goal of economic freedom as speedily as possible.

May God aid us in our united endeavours.

Jai Hind.

Shri Dildar Husain

B.E., M.I.E

President 1952-53

Presidential Address

Your Excellency, Ladies and Gentlemen,

My first duty is to thank the Members of the Council of the Institution of Engineers (India) for the signal honour they conferred on me in electing me to the Chair of the Institution. When I recall to mind the names of illustrious Past-Presidents, whose portraits adorn the Hall of the Institution at Calcutta, I feel weighed down with a sense of humility at the thought of my being unworthy of the onerous responsibilities of the high office with which the Council have been pleased to invest me. I can only say that I will endeavour with the best that is in me to uphold the high traditions of the Past-Presidents—veritable titans of engineering thought.

We are meeting under the imposing shadow of the Gateway of India which, while it is symbolical of the grandeur of our land, is also reminiscent of the fact that we have emerged from the gate of the year that has gone by—a historic year which has seen the birth of the First Five Year Plan for the nation — and that we are on the threshold of the New Year, during which we as engineers shall have to shoulder the immense task of implementing the Plan to the best of our ability. The year's end is usually regarded as a time for casting of accounts. If we can cast a fleeting glance backwards we shall see no mean record of scientific and engineering achievements, howsoever humble the beginnings. This should encourage engineers to lift their heads high with hope of the future, because there is the brightening light on the horizon of the year ahead heralding the advent of vast schemes for the economic regeneration of our country.

It is among the duties of the President to present to the members of the Institution an address on some matter of professional interest, more particularly on the subject with which his own life-work has been most closely associated. I have spent my life in irrigation engineering, but, regard being had to the most absorbing topic of the day, the Five Year Plan, which according to the Planning Commission is to become ultimately 'the focus of intense activity and a field of common endeavour throughout the country', it is only appropriate that my address should take the form of random reflections on the engineer's duties and responsibilities in the task of implementing the Plan, aptly described by our Prime Minister Pandit Nehru as a 'dynamic Plan for a dynamic nation determined to go ahead and stand on its feet'. I must, however, make it clear that the opinions expressed are, of course, my own, and are not to be taken as those of the Institution in any way. The advantage, however, of treating a subject from a somewhat philosophical standpoint is that the entire horizon can be surveyed in a detached and dispassionate manner.

It may be that some of the suggestions put forth in this address savour of the commonplace. It may, however, be stated that in the evolution of civilized society there come occasions when certain drawbacks, because of their minor significance, are apt to be overlooked, with the result that they gain a sort of universality, and no one bothers to raise a finger against them despite a subconscious realization of their existence. But if such drawbacks or deficiencies which pertain to engineering problems are discussed in a technical enclave, it may enable us to focus attention on their causes and cure.

Let us now look back for a while. The most significant development in the field of industrial and economic progress during the last two years has been the establishment of a chain of National Laboratories and Research Institutes in different parts of the country. These are destined to playa determining role in the economic rehabilitation and future progress of the country :

1. National Physical Laboratory, New Delhi.
2. National Chemical Laboratory, Poona.
3. National Metallurgical Laboratory, Jamshedpur.
4. Fuel Research Institute, Jealgora.
5. Central Food Technological Research Institute, Mysore.
6. Central Drugs Research Institute, Lucknow.
7. Central Glass and Ceramic Research Institute, Calcutta.
8. Central Road Research Institute, New Delhi.
9. Central Building Research Institute, Roorkee.
10. Central Leather Research Institute, Madras.
11. Central Electro-Chemical Research Institute, Karaikudi.

To these, it may be hoped, will be added some more research institutes during the period of the Plan.

The post-independence period in India has also seen the establishment of several important engineering industries such as the Fertilizer Factory at Sindri, the Locomotive Factory at Chittaranjan, the Steam Rollers Production Factory at Jamshedpur, and many others. Only the other day the Prime Minister opened the Rare Earths Factory at Alwaye in Travancore-Cochin, whose production, in course of time, is expected to serve as a step towards the utilization of atomic energy. Also, very recently there has been brought about the merger of S.C.O.B. and I.I.S.C.O. for expanding the production of iron and steel manufactures. Other production and processing projects such as the Machine Tool Factory, the Telephone and Cable Factories, are in various stages of development.

In the field of irrigation and power the programme drawn up by the Planning Commission covers multipurpose irrigation projects as well as minor irrigation works, and on the hydro-electric side, generation of power from water resources. No engineer who has the love of his country at heart can feel but an inward glow of satisfaction at the projects undertaken for harnessing rivers such as the Bhakra-Nangal across the Sutlej, the D.V.C. works in the basin of the Damodar, the Hirakud across the Mahanadi, the Tungabhadra, and many other medium sized projects, which are still in progress. And yet more multipurpose projects such as the Kosi in Bihar, the Koyna in Bombay, the Krishna in Madras and Hyderabad, the Chambal in Rajasthan, and the Rihand in U.P. are envisaged during the period of the Plan.

In this reference, it will not be out of place to mention that the projects already under construction are estimated to cost Rs. 765 crores out of which an expenditure of Rs. 153 crores has already been incurred, and a further expenditure of Rs. 558 crores s proposed to be spent on them. With regard to the new projects, both large and medium, whose estimated cost is expected to be of the order of Rs. 250 crores, the Plan has forecast an expenditure of Rs. 40 crores to make at least a beginning during the period of the Plan. The projects under construction are expected to bring under irrigation an additional area of 8.5 million acres and to generate 1.08 million kilowatts of additional power. After completion and full development the total addition to the irrigated area is calculated to be 16.9 million acres, and to power 1.4 million kilowatts. Minor irrigation works for agricultural development are estimated to cost Rs. 77 crores, and will irrigate an additional area of nearly 11 million acres by 1955-56.

As rightly pointed out by my esteemed friend and learned predecessor Shri Thirumale Iyengar in his recent address before the Silver Jubilee Session of the Central Board of Irrigation and Power, the irrigation and power development programme envisaged in the Five Year Plan is not an ambitious one, and with the proper priorities and irrigation engineers dedicating themselves to their task, it should be easy to fulfil.

Under the head of Irrigation and Power, the draft outline of the Five Year Plan proposed an expenditure of Rs. 448 crores during the period of the Plan, against the estimated cost of Rs. 734 crores, since revised to Rs. 765 crores. Already a firm expenditure of Rs. 153 crores has been incurred up to the end of March 1951. In the final programme of the Five Year Plan, the proposed expenditure under Irrigation and Power is Rs. 518 crores, or an increase of Rs. 70 crores over the original allotment. This would leave Rs. 94 crores still to be spent for the overall completion of the projects during the period of the next Five Year Plan. As already observed, the Plan has made a judicious provision of Rs. 40 crores for new projects in order that when the projects now on hand approach completion, the technical and other resources built up over a number of years may be usefully diverted and not allowed to be frittered away as in the past. The emphasis has no doubt been laid on bringing to completion the projects now under construction. The Commission has pointed out, and this is worthy of note by engineers, that the organization of the technical and other personnel and the mechanical equipment needed for the new projects has to be carefully planned so that the completion of one project may provide a smooth transition into the commencement of another project. This will have the added advantage of providing continuity for the technical personnel, as also the continuity, no doubt, with progressive improvement, in the technique of construction. This process should ensure increasing economy in cost and help in eliminating any wasteful features.

According to the Commission, the most economical phasing of large projects and an orderly programme of construction would be possible only if there is a long term plan, carefully prepared with accurate financial estimates and with due regard to the technical resources and equipment available. The pattern of power utilization bas to be laid down in advance, and development of generating capacity, both thermal and hydro, coordinated with the development of the load so that there is as little lag as possible between power generation and its utilization. This therefore imposes serious responsibility on engineers dealing with irrigation and power. It is, however, necessary that expansion of the power supply industry should be carefully coordinated with plans for industrial expansion, rural development, and educational uplift. Greater emphasis seems to be called for on the development of areas more backward than others, in preference to further expanding supply in areas already well served, in order to effect a balanced overall development. This would need careful planning on a regional basis keeping in view the optimum relation between the use of water for irrigation and for generating power. and to this end a very thorough understanding of mutual problems between irrigation and power engineers and the fullest cooperation among them will be a *sine qua non*.

The advent of river valley projects has helped to create an awareness among the engineers of the need of a creative effort to bring out scheme after scheme for irrigation and power, but past experience has shown that in several cases works were started with insufficient technical investigation and a somewhat incomplete assessment of the economic aspects. In these days when we have become accustomed to talk in terms of crores, a little departure of a crore here or a crore there may not seem much, yet from the common man's viewpoint. criticism might justifiably be levelled against the engineer for being responsible for inflation in the cost of work despite his professed economy. Reasons such as increased cost of construction due to the vagaries of a rising market and labour, encountering unexpected geological strata in the foundations of the dams and appurtenant works, changes in the cost of canal construction due to alterations in the alignment of canals, while they may satisfy the engineering mind, do yet carry within them the germ of an implied admission of inadequate preliminary investigation. There seems no reason why in a project, supposed to have been started after careful investigation. there should be need of its subsequent revision on the plea of an increased irrigation and power potential. If anything, it goes only to show that the original investigation was far from complete. The Five Year Plan, therefore, deserves careful study indeed from time to time, regarding it somewhat akin to the Book of Meditation, by all engineers having anything to do with irrigation and power engineering.

Where an irrigation and power project is such that its benefits have to extend to more than one territorial region. the project should be conceived on a national rather than a regional basis. There should be a complete coordination between the engineers of the different watersheds. There should be no tendency whatsoever during the processing of the scheme to keep sub-rosa certain benefits in the interests of one region to the exclusion of another. You cannot have smiling plenty on one side, and frustration or destitution on the other, as this would merely tend to raise vast psychological and human problems. Nor should any engineer allow his wagon to be hitched to any particular political or ideological star, and let his best judgment be overcome by passion or prejudice. It will, therefore, be in the fitness of things that when the investigations of a multipurpose and multiobject project have been completed. the different engineers who are parties to the project sit at a sort of round table conference, where the entire scheme should be freely discussed and subjected to the severest criticism, without leaving any trail of bitterness behind. The youngest member of the team might perhaps be able to offer suggestions and put forth constructive ideas which may have escaped the notice of the senior members. There should therefore be a complete openness of mind between the young and the old in discussing these schemes, and nothing should be left by way of engineering assumptions and chance. One of the commonest but nevertheless most trenchant criticisms levelled against engineers is the revision of their estimates. In the pre-independence period of India, it used to be an unfortunate experience — may be it lingers even now — that revised estimates followed the sanctioned estimates as the night follows the day. Whatever may have happened in the past, there is no justification, at least in the context of our new Republic, for such a malaise to continue.

Efficiency

It will be laborious to go into the details, but the key to the whole problem lies in one word, efficiency, or skilled management. The latter is an essential factor in achieving efficiency in the face of the inherent complexities of large modern constructions. It takes into account not only the efficiency of designs, efficiency of the technical personnel, efficiency of the executive and contracting agency, but above all a complete efficiency of mind on the part of those responsible for directing the operation of project works. In the earlier stages of a project, when there is a free flow of funds, the dazzle of new operations and an overweening zeal for accelerated drive is apt to over-ride the sense of balance between expenditure and its return. It is, therefore, important that both in the projects under construction and those to be taken up in future, there should be instituted what is known as operational research, in other words, a department of statistical analysis of the cost of production. This practice is invariably adopted in industrially advanced countries, under the title of cost analysis and cost control. The first step in achieving efficiency is to make up one's mind that efficiency is worth striving for, and that to achieve it will require something more than just cooperation, common sense and a few calculations on the back of an envelope. The way to cut down costs is to cut down waste, often invisible, be it in office, or establishment, or operational personnel, or on construction, but waste all the same. Its cumulative effect becomes visible only when the springs of finance begin to dry up when the work on a project has advanced to a stage when its completion comes within a measurable distance of time. Observations and measurements of 'inputs' and 'outputs', in other words, the resulting effect of the cost of materials, the cost of construction, plant charges, and overheads could be statistically interpreted to show why in any particular direction something is going wrong that had not been apparent previously. These studies should enable the engineers in charge to determine what variations have occurred, their extent and causes, to discover conditions underlying each cause, and to develop or revise policies, plans, methods and practices, for the purpose of eliminating unfavourable conditions and waste, and to apply these procedures to situations which call for cutting down costs.

Watch and ward in large projects

The total expenditure on the various projects included in the Five Year Plan is estimated at Rs. 2,069 crores. The amount will have to be found not only through internal resources of the country but perhaps from external sources as well, if the plan has to fulfil its objectives within the period set for it. This, therefore, makes it necessary that a time schedule should be fixed for each type of project, and the authorities or the departments concerned should be made responsible for seeing that the works proceed in strict accord with the schedule. River valley schemes lend themselves to construction by stages both as regards irrigation and power. Maximum utility can only flow if these stages are scientifically planned, and the schedules drawn up are duly adhered to. Neither should departures from the schedule be permitted, nor progress allowed to be hampered by official faineantism and red-tape involvement, nor should the springs of efficiency and economy get clogged by the tooth of audit's routine criticism, too often biting the tongue of the engineer's wisdom. Shri Thirumale Iyengar in his address at the Silver Jubilee Session of the Central Board of Irrigation and Power laid the right emphasis when he pointed out the 'irksome accounting and audit procedures that hold up progress' in the projects due to the combination in one officer of the dual functions of Financial Adviser and Auditor, whereby this officer becomes virtually a controller over the administration of the project without being responsible for the resulting delays. For these the public lays the blame at the engineer's door. This is not a satisfactory state of affairs. Delays in construction, from whichever cause, are bound to enhance the cost in various ways such as increased cost of establishment, increased cost of materials, services and supplies due to fluctuation of the market, Some via media must be found, and I believe it should not be difficult to find one.

A step which suggests itself in this direction is a Standing Supervisory Commission invested with the duty to supervise and report on the progress of the various projects, to examine whether the finances are being soundly administered, and to point out delays in any field to enable the administration concerned to take timely steps to remove the bottlenecks. Such a Commission will also help to inspire confidence in the public mind.

Engineering specifications

In the context of efficiency, it seems desirable that there should be an all-India effort to bring the specifications of work up-to-date, and also to have them revised from time to time, according as new types of construction are taken up. It is feared that many a specification adopted. during the British period is still followed in many places without any material improvement, and these have therefore become a fruitful source of controversy, leading possibly to lowered quality of work at increased cost. In the pre-independence period many of the Indian States which are now part of the Republic had specifications of their own without (relevance to the standards of modern engineering practices. Specifications ought to keep pace with new methods of construction and the results obtained from research. In regard to new techniques of construction of dams, foundation engineering and soil mechanics, or still newer processes such as prestressed concrete, quality concrete, temperature controlled concrete, or new methods of handling and transporting materials such as conveyor belting or pumping concrete, specifications will have to be obtained from abroad and suitably modified to suit Indian conditions in the light of experience gained from their operation and use.

Technical Literature

There is a prevailing deficiency of technical literature in our country, with the consequence that our engineering standards are getting impaired. Reports on completed works generally receive scant attention. Their formulation is looked upon perhaps more as departmental ritual than a contribution to engineering literature. Many of them are never printed or published owing to financial considerations. One does not see these days anything like the professional papers published by the Madras Corps of Engineers in the nineteenth century by that distinguished band of engineers under Sir Arthur Cotton.

As an instance it may be observed that until perhaps the twenties of this century, tunnels in connection with irrigation and power projects were generally unknown. No doubt the railways had adopted tunnels on their lines. The first tunnel for irrigation was adopted on the Upper Swat Canal. After a long gap of time came the Uhl river hydro power tunnel, followed by the Hulekiri tunnel on the Irwin Canal in Mysore. Great fears were entertained on every occasion, but the Indian engineers were able to complete the works successfully. Tunnelling has now become a common feature of modern irrigation and power schemes in India. But in how many technical libraries of Government secretariats, or in those of the Institution, are there available reports and specifications for this class of work? The experience gained on the construction of recent tunnels should enable a code of specifications and operation to be drawn up for the benefit of all engineers. As things happen to be, a good deal is left to the judgment of the engineer in charge, personal factors often coming into play at different stages of. work, affecting the cost factor.

It is not my intention, beyond making a few general observations, to delve into the highways and byways of the fundamentals of the Plan in regard to the principal requirements of the nation, namely, Food, Housing, and Clothing and their wide implications. Any discussion in regard to Transport and Communication may well be left out as it is bound to come up for detailed consideration before the Indian Roads Congress.

Housing

The subject of housing is, however, one which has not received the full scientific attention it deserves. Although in several regions engineers have been labouring over a number of years with this problem, yet owing to the lack of a coordinated plan the results achieved have remained, at best, of local effect, and even among these no final solution has been reached.

It is gratifying to note that very recently there has come into existence an institution known as the All-India Housing Association with headquarters at New Delhi. This Association aims at developing into a country-wide organization, comprising a number of Primary Housing Associations, District Housing Committees, and Regional Housing Councils with a Central Board in New Delhi. This Association, if it is to be a success, will have to be guided by the results of scientific investigations on the different problems relating to housing in different regions of India. Houses have to be provided not only for industrial labour in urban areas, but also for agricultural labour in rural areas, and for labour engaged in arts and crafts in some rural or semi-urban areas. The social and occupational requirements of the people vary from region to region. Special consideration has to be given to areas liable to conditions ranging from those of aridity as in Rajasthan to heavy rainfall as in Malabar and Travancore-Cochin, or extremes of temperature as in Punjab (I) and Himachal Pradesh. In these zones indigenous styles for the construction of houses in rural areas have been evolved by the process of time and experience. It is therefore important that there should be a region-wise study of the patterns of housing adopted in the various rural areas, the materials used, and the style of construction adopted. These statistics should provide a useful base for scientific study, after which a rational design suited to the genius of the people could be worked out for the different parts of the country.

Any attempt to superimpose a tailored design for rural housing, based on the experience of urban or semi-urban housing, or suggesting the use of materials evolved in laboratories, is not likely to find favour. These things might only put back the hands of the clock. In fact it appears that the trend of the conclusions recently reached at New Delhi through the symposium on scientific principles and their application in tropical building design and construction, lends a point for these considerations. It is a sad commentary that we engineers in India should have waited all these days for the initiative to be provided by the UNESCO and the ECAFE and their sister organizations. Nevertheless the problem is a colossal one, and must be faced with determination.

I understand that the All-India Housing Association is trying to enlist the cooperation of some retired Chief Engineers and Superintending Engineers, in addition to the engineers dealing with housing in different parts of India, in order to obtain the best advice on planning houses suited to the requirements of the different types of people inhabiting the various regions of this sub-continent, as well as the materials most economically available in each region. No doubt there have been some sporadic attempts in some parts of India to evolve a suitable type of low cost house, but this type is intended more for urban areas. Not even the fringe of the problem of rural housing has been touched. I know of one region where colonies for expropriated persons were built with houses of a modern style. These did not appeal to the population and so much metamorphosis was resorted to by the occupants that in few years the so-called modernism was left but in name. Such mistakes have to be avoided, especially when houses have to be provided for the persons displaced from the submerged areas of the river valley storage reservoirs. It will indeed be the magnum opus, of Indian engineers if this nation-wide problem is effectively solved in the shortest time possible. Now that a start has already been made with the community projects in which housing forms an integral item, houses will not only have to be properly designed but each housing scheme should be backed by a properly prepared environmental layout plan in which the town planner will have to play his part. Any scheme of housing undertaken without a scientifically prepared layout plan will amount to putting the cart before the horse. It will only tend to create new slums in place of old. The situation is not very different from what it was in war-devastated Britain, except perhaps for a difference in characteristic and degree. The words of Mr. Winston Churchill, in one of his wartime talks in 1943, seem to be significantly applicable to our case:

> 'We have one large immediate task in the replanning and rebuilding of our cities and towns. This will make a very great call on our resources in material and labour, but it is also an immense opportunity not only for the improvement of our housing but for the employment of our people.'

Industrial productivity

The Planning Commission has observed that 'although agricultural development including the building up of the necessary basic services like irrigation and power has the highest priority, this does not mean that industrial development as such is less important. Improvement in agriculture itself cannot proceed beyond a point unless the surplus working force on the land is progressively diverted to industries and services. The productivity of labour in industry is much higher than in agriculture and this also points to the need for rapid industrial development.' 'Industrial productivity', to quote the words of the Commission, 'is a function of several variables such as the size of the plant, the quality of raw materials used, the efficiency of technical personnel, the quality of the labour force, and the efficiency of the management in coordinating to the best advantage the various factors of production. Improvement of productivity must, in the years to come, be a major objective. The technique of quality control designed to bring about a reduction in the consumption of materials and an increase in operational efficiency should be widely applied in the industrial field.' In this connection the reports of the Anglo-American Council on Productivity bearing the titles 'Universities and Industry' and 'Education for Management' are of interest to us in this country. Addressing the British industrialists, the first report says, 'leader of British industry, in all grades and sections, should recognize and study the very high place accorded by American industry to the application of science and scientific methods in the solution of its problems.' The team of experts responsible for these reports has made certain recommendations, which might as well be kept in view in reference to our industries. These are:

1. Recruit a larger proportion of persons educated in full-time courses, either at the universities or technical colleges;

2. Afford such persons ample scope and encouragement so that full benefit may be gained from their education ;

3. Encourage specialist members of staff to place their knowledge at the disposal of the universities and technical colleges for instructional purposes;

4. Provide facilities for the initiation and training of recruits from universities and technical colleges in specific fields in cases where such provision is not now made;

5. Extend facilities for releasing members of staff for higher education.

In general the experts have recommended the encouragement of a closer association between the universities, technical colleges and industry through the media of graduate associations, conferences, appointment boards and other means. Manifestly,. the Institution of Engineers can playa vital part in bringing about such a collaboration which is implicit in the objects and purposes set out in the Royal Charter of the Institution,

In the context of specialized courses in engineering to turn out engineering graduates capable of being readily absorbed in special types of engineering industries, it seems that the time has come when the engineering colleges in our country should somewhat re-orientate the courses of studies to meet this demand. Our universities all over have been turning out stereotyped graduates in Civil, Mechanical and Electrical Engineering. Are our universities in a position to provide an answer should a demand arise, as it is bound to do, in the fields of Structural Engineering, Automobile Engineering, Petroleum Engineering, Aeronautical Engineering and other similar branches. This subject has been so ably dealt with in the Report of the University Education Commission that any further observations on this aspect of technical and engineering education would amount to carrying coals to Newcastle. However, I may take the liberty of suggesting that the chapter on engineering and technology is worth the study of all those engineers and professors who are associated or concerned with the problems of engineering and technical education in India.

Industrial development and defence

I must now turn my attention to two subjects which have agitated my mind for a long time, and which in my opinion constitute the steel frame of a national economy. These are Defence and Naval Engineering.

It is perhaps not fully appreciated that in all industrially advanced countries a close relationship has existed between the practical utilization of available resources, in other words, industrial development and defence. Reciprocally, defence requirements help to accelerate the pace of industrial development by the evolution of new scientific processes, by utilization of newer raw materials, and even development of new substitutes, leading to industries whose importance or possibilities have been found vital not only during peace-time but also in the event of an emergency, as for instance, electronic industry or the fixation of nitrogen to produce ammonia and nitric acid. Here is, therefore, another field in which engineers can play an important part along with men of fundamental science such as physicists, chemists and others, in as much as problems relating to defence range from ballistics and thermodynamics of explosives to communications, soil research, food and allied subjects. It is, therefore, more than ever necessary to create an! awareness of the importance of the early and systematic development of engineering industries, such as aircraft construction, machine tools and precision instruments, chemical industries such as manufacture of sulphur from gypsum, and electrical industries, to name only a few, whether on the public or private sector, for which the services of the engineers will be indispensable. Indeed it is difficult to draw a line of demarcation between a defence industry per se, and an industry intended to produce capital or consumer goods. At the same time it is necessary that if the twin objectives of solvency and security are to be achieved in the interests of the nation, no doubt through hard and prolonged scientific and engineering effort, there ought to be a greater recognition not only of the engineer's services, but also an appreciation of his counsel which as an applied scientist he may be able to place at the disposal of the administration for the framing of an engineering and industrial policy.

Marine engineering

It is a fact universally recognized, and by maritime countries in particular, that the possession of an effective National Mercantile Marine is essential not only for the promotion of a country's trade and the prosperity of its industries, but also for its defence. In the words of the Planning Commission's Report, 'a Mercantile Marine is a second line of defence in times of crisis. It serves not only as an auxiliary force but also as a training ground for the Navy, besides being indispensable for the carriage of essential supplies from overseas in times of war.' It has been aptly described as an element of prosperity in times of peace and a fourth arm in war. Looking to the strategic position occupied by India in the Indian Ocean and for the matter of that in South-East Asia, the conclusion is inescapable that India's Mercantile Marine should be sufficient not only to carry its water-borne commerce but also to provide shipping service on all routes essential for the flow of such commerce at all times.

According to the Planning Commission, the Shipping Policy Committee had recommended in 1947 that the target for Indian shipping for the subsequent 5 to 7 years should be a total of 2,000,000 tons. Although since our independence the Indian-owned tonnage has shown an improvement from 100,000 G.R.T. in 1946 to 417,257 G.R.T. in 1950, yet, having regard to the financial resources available, a programme of development has been formulated which aims at increasing the total gross registered tonnage in the coastal and overseas trades by about 600,000 by the end of the period of the Plan. This appears hardly satisfactory when compared with even the prewar tonnage of some other countries, e.g. :

United Kingdom	19.7 million tons
U.S.A.	13.4 million tons
Japan	4.3 million tons
Germany	3.0 million tons
Canada	1.475 million tons

Nonetheless, in view of certain international factors coming rapidly into existence, the problem of an adequate Indian Mercantile Marine calls for a very high priority. In this connection, it is to be remembered that during the years following World War II, the potential mercantile fleets of certain countries remained inoperative. For instance, the German, Italian and Japanese fleets were out of commission. Following, however, the removal of political restrictions and increasing financial rehabilitation, these countries are fast building up their merchant marine. These are likely to become potential rivals to Indian shipping even if it comes to attain the necessary tonnage for the overseas trade. Therefore, unless Indian shipping progresses rapidly and takes the field without loss of time, it is most likely to find itself at a disadvantage, once foreign interests have taken root.

Owing to the shortage of vessels and other reasons, the amount paid by the Government of India for the carriage of food in foreign vessels during the last four years runs, it is believed, to crores of rupees. With adequate merchant marine not only could such expenditure remain confined to the benefit of Indian shipping but also it would help in conserving foreign exchange. The fact cannot be overlooked that other countries have been keenly aware of the advantage gained from the balance of payments as a result of the earnings by their national shipping.

The problem of coastal shipping is no less important. With vast natural resources still undeveloped and with a coast line extending over 2,500 miles, and the present capacity of the five existing major ports to handle cargo having reached almost a saturation point, there is a strong need for the rapid development and modernization of some of the major ports, and the improvement of the subsidiary ports, together with arrangements for handling heavy and special machinery where necessary. As an instance, it may be mentioned that the Calcutta port authorities had to make unusual craning and docking arrangements when the stator weighing 110 tons for the Bokaro Thermal Station of the D.V.C. was received.

For the development of shipping industry, India needs more shipyards than what we have at present. Whereas a very modest target of a total of 600,000 C .R.T. has been set for the end of the period of the Plan, it is estimated that during this period the only existing shipyard would be able to turn out a tonnage of 100,000. This would mean that the rest of the tonnage will continue to be procured from external sources. It will be a source of gratification if a greater and greater number of our engineers are absorbed in the shipbuilding industry, and they are afforded opportunity to contribute their talents and labour to produce Indian merchant vessels capable of answering the trade requirements in the years which lie immediately ahead. As matters stand, there are over-aged ships of 60,000 C.R.T. which have first to be replaced. A national effort, coupled with imagination and foresight, even as a measure of war emergency, is urgently called for if this dichotomy is not to keep the Indian shipping industry behind time.

Naval engineering courses in the Universities

Here we may pause to examine whether the courses of education and training in the engineering colleges of Indian Universities are such as are likely to equip our young men with the knowledge that should enable them to be readily absorbed in the shipping industry. An examination of the syllabi of some of the principal universities shows that although the bulk of subjects required for the marine engineering course, such as theory of heat engines, steam turbines, internal combustion engineering, boiler chemistry, etc., are covered by the courses. the subject of naval architecture and ship construction have received little attention. Among the British Universities, Durham and Liverpool award degrees (ordinary and honours) in naval architecture and marine engineering. It will, therefore, be in the fitness of things if the Universities of Bombay and Calcutta, because of their proximity to the sea, consider instituting similar courses. The subject of docks and harbour engineering has, by and large, occupied a secondary place in the university curricula, being treated as a part of irrigation and waterways. Nothing could be more incongruous. It seems, therefore, advisable that just as the subject of soil mechanics has recently come to receive special attention in the syllabi of some of the universities by providing a special paper on the subject, the subject of docks, harbours and naval architecture should form a separate paper. For the benefit of those who wish to specialize in marine engineering, it should not be difficult for the universities to make suitable arrangements for post-graduate training under the port authorities or at large engineering workshops in the overhaul and repair of mechanical or dock plant or floating craft. The provision of Rs. 1.1 lakhs made in the First Five Year Plan for the technical training of the necessary pool of officers, engineers and crew for Indian shipping seems to be disproportionately low.

There is at present only one Marine Engineering College in India with a limited output of marine engineers who are awarded a diploma. This is not adequate. With the growing needs of the Indian Merchant Navy, it will be necessary to step up the outturn, by establishing more than one marine engineering college, comparable to the Royal Naval College, Greenwich. Further, a marine engineer, once he goes to sea, should not come to feel as if he was a forlorn mariner, having little or no contact with the wider sphere of the engineering profession, and labour under the disadvantage of having been cut off from the community of engineers. The Institution of Engineers (India) has recognized for exemption from Sections A and B candidates who hold diplomas of British naval colleges, and also those candidates who qualify as Lieutenants (E). There seems no reason why, provided the courses of marine engineering as at present obtaining in this country conform to the standard of British institutions, the marine engineers who qualify from the Marine Engineering College should not get the benefit of the Corporate Membership of our Institution, and feel the glow of the esprit de corps of the engineering community. One of the means of securing accelerated training for those graduates in mechanical and electrical engineering who are interested in marine engineering would be to provide short-term scholarships for their training abroad.

Another matter of considerable significance to the shipping industry which lies within the province of engineering is the survey of the sea around India's littoral. In his address before the Defence Science Conference, Dr. Bhatnagar drew attention to the fact that, despite a long coast line, no detailed coastal map of India had so far been prepared. One of the major undertakings, he observed, awaiting the Defence Science Organization, was a regular survey of the coast line and the surrounding seas. Such a survey conducted with the help of ultrasonics will be of infinite value not only to the Indian Navy; it will be useful for commercial navigation, and incidentally help in locating shoals of fish for development of fisheries.

Our Institution

President after President, each in his annual address, has stressed the importance of this Institution, the privilege of its members, and their corresponding obligations. Considering the fact that our Institution is still going through a formative process, our revised Bye~laws having come into effect from March 1952, I feel that I cannot do better than reproduce the words of one of our distinguished Past-Presidents, Sir Clement Hindley, spoken before the Punjab Engineering Congress when that body was being wooed to merge into the Institution. 'The Institution', said Sir Clement, 'is an all- India body expressly designed to' further the federation of engineering societies and associations in India. Its aims and objects are primarily to uphold and consolidate the engineering profession in this country, and to ensure that it is placed and maintained in a position which will secure respect in the eyes of the public. The Institution aims at maintaining the standard of professional qualifications so that its membership may be the hallmark of the engineer in India, to whatever branch of the profession he may belong'. To this may be added the responsibility devolving on the members by the distinction of being called Chartered Engineers, as the result of the Royal Charter granted to the Institution, which, no doubt in due process of time and circumstance, will come to be replaced by a corresponding Indian Charter but charter all the same. What special charm, asked someone, has the Chartered Engineer? The answer is that if an engineer belongs to a chartered body, then because that body has approved of its member, the man comes to have a status as being of some standing in his profession, and which another may not have if he is not a member.

Our Institution is the youngest among the Engineering Institutions of the British Commonwealth, yet, compared with the size of the country and the number of engineers existing in the country, and the engineering graduates annually turned out by the Indian Universities, the growth of the membership has been slow, although of late there are signs of an increase in the quantum of membership. In this connection it will be interesting to compare our membership with the membership of the Engineering Institutions of 'the Commonwealth. These are given in the statement in the Appendix.

Work done by Commonwealth Institutions

Some features of these Institutions are well worth study. These Institutions command the .respect of their respective Governments. They are invariably represented on every committee or commission whose work has anything to do with engineering. They evaluate the qualifications of engineers and wield considerable influence in the framing of regulations for the appointment of engineers to Government and other organizations. In all these Institutions greater stress is laid on the quality of technical papers, frequency of technical discussions, and the printing and circulation not only of technical papers but also of engineering literature, science abstracts, reports and memoirs, as for instance 'Geotechnique' by the Institution of Civil Engineers, 'W.E.P. (War Emergency Proceedings)' by the Institution of Mechanical Engineers, or 'Wiring Regulations for Buildings, for Ships, and for Aircraft', and 'Model General Conditions of Contract for the Engineering Industry' by the Institution of Electrical Engineers.

Reference library and Engineering Divisions

The greatest need of our Institution is a strong reference library at the Head Office and corresponding nuclei at the Local Centres. As an instance it may be mentioned that the Engineering Institute of Canada alone has a library of 10,000 volumes, staffed by four people including three professional librarians. The number of reference enquiries registered in 1950 was 8,600.

It was but proper that not long ago we decided in the Council to open four Engineering Divisions for Civil, Mechanical, Electrical and General subjects of engineering. Nevertheless, in view of the wider ramifications of engineering science and the rapid advances in the different branches consequent on researches, it would assist the furtherance of our activities and lead to the creation of still wider interests if some of the Engineering Divisions formed in our Institution are further bifurcated into sections, as for instance, Chemical, Aeronautical, Transportation, Soil Mechanics and Foundation Engineering, Marine Engineering, and Industrial Management.

Research

Although researches are being carried out in the different engineering laboratories in India, our Institution becomes aware only perhaps indirectly of the researches undertaken and the results derived from them. Even this is more an exception than a rule. In the case of the Institutions of Civil, Mechanical and Electrical Engineers, London, each of these Institutions has a standing research committee which advises the Council on matters of research affecting the work before the Institution. These committees are responsible for investigating proposals for research and suggesting items of research to Government Departments and elsewhere, and interpreting the results of research for the benefit of the members of the Institutions.

There are at present diverse channels of engineering research in our country. Problems of research relating to irrigation and hydraulics are being undertaken at the various laboratories and field stations according to the programme laid down by the Central Board of Irrigation and Power, or at the instance of the Engineering Departments of the State within whose jurisdiction the laboratories are situated. Problems of road research are being handled largely by the Central Road Research Institute, New Delhi, and also at some other laboratories in the States. Thus there is the possibility of an overlap occurring in the work of research whether the problem falls in the province of irrigation, or roads, or under the category of building materials. If there were a central organization where the problems of research could be classified, and the results catalogued in a scientific manner, it would help to economize time and energy by eliminating the possibility of parallel investigations being undertaken on the common aspects of the problems by the different research agencies at one and the same time. For instance, the results of researches in regard to soils are of as much value to the road engineer as to the engineer in charge of irrigation works. Although in the majority of cases the engineers engaged in research are themselves members of the Institution, yet the reports of the researches carried out by them are sent primarily to the State Governments concerned or presented at the research session of the Central Board of Irrigation and Power. The same could be said of the researches carried out in regard to roads. The results of these researches too do not become available to engineers in general unless they are members of the Roads Congress. Again, whether for the future research worker at the post-graduate level in the university or for the budding engineer seeking the light of earlier researches to resolve a particular engineering problem, there is no central organization where this information can be readily obtained. In the case of the members of the Institution who have retired from service, the chances of keeping their knowledge up-to date in connection with the research work are even more remote. It seems therefore necessary that there should be some sort of coordination whereby the results of these researches are made available to the wider community of the members of the Institution. The Institution of Engineers could, therefore. usefully serve as the ele aring house for all research information. The problem is indeed so vast that it requires detailed consideration. It is not possible in the space of an address to make more than a passing suggestion.

Social activities

In the majority of the engineering institutions of the British Commonwealth. particular emphasis is laid on social activities. which help to enhance the interest of the Corporate Members. These activities take the form of social functions, balls, luncheons, conversaziones, and visits to scenic areas, installations, industries, and other places of attraction. Some of the technical meetings are made less formal and ladies are invited. With the diversity of engineering interests represented in our Institution. we might as well take a leaf out of their book.

Floating centres

In furthering the objectives of the Institution, it should be the business of Local Centres to maintain the interest among the members and keep them active in the affairs, of the Institution. For some years past there have been large-scale concentrations of engineers in connection with the river valley projects. such as Bhakra-Nangal, Hirakud, Damodar Valley and Tungabhadra, or at centres of heavy industries such as Jamshedpur, Sindri and Chittaranjan. One major difficulty of the engineers in these regions is the distance which separates them from their Local Centres due to which, as also due to the need of their frequent on the-spot presence, many of them cannot attend the technical meetings and take part in discussions to which they could usefully contribute their views and latest experience based on the many and varied problems tackled by them. Such schemes of work are bound to continue for many a year to come. It will, therefore, be a step in the right direction if within the sphere of Local Centres, floating centres in the shape of engineering divisions and even subdivisions could be opened, depending on the magnitude and the geographical dimensions of a project. These divisions and subdivisions should provide well-planned programmes of technical and social activity for the members residing within the project or even the adjoining areas. They may even hold annual dinner meetings as a part of the centre's activity. The papers read in the project zones and their attendant discussions would provide a valuable engineering record for the parent Local Centre. Experience of past projects has shown, as I can recall with a twinge of regret, that vast quantities of designs, drawings, specifications and technical reports came to be consigned, once they had served their purpose, to the limbo of office records, never again to see the light of day. Many a good idea. and the 'know-how' evolved from hard and bitter experience on various jobs, gets submerged in routine records, with the result that other engineers, when faced with similar problems, have probably to go through the same trial and error processes, often very costly; but if they had the means to study what someone else had done in the same line elsewhere. they would not have stumbled into a similar pitfall or made a like mistake. There is often a tendency among junior engineers to hide or gloss over mistakes. apparently due to the fear that the disclosure of mistakes — not due to professional ineptitude but because for the nonce. the forces of nature got the better of their professional knowledge or judgment — may detract from their professional value or bring down the displeasure of the departmental head. This is a fallacy. Any engineer of experience if he were to look back on the milestones of life left behind could easily testify that his experience and reputation were built on the foundations of mistakes at least not avoided, if not committed, and largely through the study of mistakes committed elsewhere. The Chief Engineers of States will be doing a service to the Institution if they can send, periodically, copies of technical papers, reports of projects, investigations of any untoward results, specifications of special types, and even copies of reports submitted by officers returning from visits of engineering projects and installations, for reference and record in the libraries of the Local Centres of the Institution.

Local Centres vis-a-vis engineering colleges

Education of a specialized nature to fit engineers for industry has exercised the minds of several Past-Presidents of this Institution, as also of eminent educationists and industrialists in this country. In the United States, Germany, Switzerland and in other Continental countries, much has been done at various levels to give adequate training to suit young men about to start their working life in industry. A question that might justifiably be asked is whether our colleges and universities are giving the best education for entrants into industry and other fields of engineering. Is there any arrangement for ascertaining the views of the young men who have been in industry or an engineering department, say for three or four years following their academic training, to find out the lacunae which they have found in facing the problems coming up before them? Such views would be helpful in examining the pattern of training imparted at the university, namely, whether the professorial staff, have been equipping the students with the best of knowledge, or whether they have been largely allowed to be crammed with potted knowledge in order that they might just get through the examinations. It should not be left to the employer in industry or the heads of engineering departments to pronounce one day that the products of a particular engineering institution are below the mark. A bad tradition takes years to live down, but in the meanwhile large-scale damage will have been done. It is, therefore, among the functions of this Institution, through its Local Centres, that vigilance is kept of the high standards to be maintained by the engineering colleges and technical institutions whose degrees or diplomas have been recognized by the Institution. It is, in my opinion, the duty of the Local Centres to examine periodically the syllabi, the laboratory training, and the system of shop practice and field work in the engineering institutions within their territorial boundaries, and to bring to the notice of the academic authorities as well as the institutions concerned such deficiencies as may be found to exist both in regard to the courses of studies, the teaching staff, and the equipment, in the light of modern advances in engineering theory and practice. It is important that in the courses of engineering a bias is provided towards research and its application, and it is the duty of the professors themselves to set an example by taking up research work at least of academic nature.

Before leaving this subject I feel that I would be failing in my duty if I did not reproduce here the observations, howsoever unpalatable they may be, contained in the Report of the University Commission (1948-49) headed by Dr. Radhakrishnan :

'While in England individual professors and teachers in other ranks have made detailed study of technological problems and carried out important researches, so that bodies of consultants, design and development engineers, and executives have grown up—such has not been the case in India. Indian engineers, with some notable exception, have not gone beyond grade 2, carrying out routine duties, and have very rarely been trying to improve processes, or bring an original mind to the innumerable problems confronting the engineer.'

A.M.I.E. Examination

The minimum educational qualification recently approved by the Council of our Institution which entitles a candidate to exemption from the Studentship Examination is Inter Science of any recognized university. There are also diploma examinations of certain technical institutions whose candidates are exempted from the Studentship Examination. It is also laid down that in the case of a student who is not being trained in a recognized engineering college, he should produce a certificate from two Members of the Institution that he is qualifying himself for the profession of an engineer. Now, a student, may receive practical training on indoor or outdoor work, and also in engineering drawing, but what avenues are open to him to study the basic subjects such as hydraulics, thermodynamics, geodesy, and a host of others which form the syllabus of the AM.I.E. Examination? It is, therefore, to be assumed that a candidate aspiring for AM.I.E. manages to receive private coaching in the subjects of his choice. The very large number of failures in the annual examinations of the Institution goes, however, to I prove that the candidates are toiling under a grave desideratum. There is a woeful lack of avenues of training in the basic subjects. It is, therefore, necessary that our Institution should consider some via media to enable the students receive training in basic subjects, and thus save the energies of the young men from being frittered away. A solution which occurs to my mind is that those technical institutes and polytechnics which award licentiate diplomas in engineering, should come forward to open part-time evening classes in engineering to prepare students for the A.M.I.E. Examination. Such courses cannot, however, be expected to be selfsupporting, and therefore the Government concerned should contribute up to two-thirds of the cost if required. The Osmania Technical College, Hyderabad, has set a commendable example of opening the A.M.I.E. classes outlined above. Their example could be usefully followed by other technical institutions.

Women engineers

A topic of considerable future importance regarding which I may indulge in some loud thinking is the need of women engineers in this country. The need for this is underlined by the enormous expansion programme envisaged in the Five Year Plan and further programmes which may be adumbrated by succeeding Plans. Barring one or two engineering colleges in India, where one or two lady students entered the engineering faculty, lady graduates or undergraduates in science have not turned their attention to the field of engineering science. Possibly, prejudices and inhibitionsst and in the way, which have to be overcome. But, if we wish to bring to fruition the various. schemes of construction, power, industrial development and research, to mention only a few out of the many in the Five Year Plan, we must seriously consider the question of having lady engineers, administrative managers, professors, and research workers in engineering, in order to effect a rapid increase in the technical 'manpower'. In this respect, China affords an instructive example. There the women seem to be very much awake. One of the former Presidents of our Institution, Nawab Zain Yar Jung, who visited China not long ago as a member of the Indian Delegation, gave a talk on his return on the subject of engineering development in China, an excerpt of which is given below:

'An activity worthy of notice is that Chinese women today take an active part in gigantic water conservation projects. Six hundred and fifty thousand women took part in the channel clearing work; during one year, over 250,000 women worked on the dyke construction work at the Huai River Project. Some of the women drive piles together with the men. They drive tractors and pilot aeroplanes. The non-stop express train from Peking to Tientsin is run entirely by a women crew. Individuals have invented advanced operational methods and new industrial techniques. Madame Chien Chenge Ying is an engineer of great ability and distinction. and she is now the supreme head of the Huai River Harnessing Commission and its works.'

This should be an eye-opener to us in this country, whose problems of backwardness and population are not dissimilar to those of China.

Ladies and Gentlemen, I fear that I have taxed your indulgence in having inflicted upon you a somewhat lengthy address. I must, therefore, thank you for having given me a patient hearing. I would like, with your permission, to conclude my address on an individualistic note. Engineering being a science in which facts and imagination jointly combine 'to direct the great sources of power in Nature for the use and convenience of man', it is perhaps natural that in a fast moving world in which the economy of a backward and industrially underdeveloped country such as India's has to be built up, in order to bring within the grasp of the people as much fullness and richness of life as possible, the engineer's imagination should travel far and wide. Charles Kittering, an eminent research consultant, in his address at the first fall assembly of the Antioch College, Ohio, said very truly about engineers, 'The world does not run out of things; it only runs out of brains'. The engineer, therefore, more than anyone else, should be able to discern the signposts and the milestone set by the Five Year Plan, and, undaunted by difficulties, endeavour to carry his part of the burden along the highroad to progress. Elsewhere the combination of engineers. scientists and technicians has enabled several Five Year Plans to be completed in four years, converting the nation from extreme backwardness into 'a nation of metals, of automobiles and tractors'. Will it be too much to expect the same for India? The answer to this question lies with engineers.

Major General Harold Williams

C.B., C.B.E., M.I.C.E., M.I.E., M.I.S.(Ind.)

President 1953-54

Presidential Address

Shri Krishnarnachari, Ladies and Gentlemen,

My first duty-a very pleasant one-is to thank the Minister of Commerce and Industry for the honour he has done the Institution in accepting our invitation to be present at our Annual General Meeting. We are very grateful to you, Sir, for agreeing to be our Chief Guest. In the discharge of your responsibilities as Minister of Commerce and Industry, you must constantly be aware of the magnitude of the task of raising India's industry to a level compatible with the needs of her people and the importance of her position in world affairs. Much of this task must devolve on the shoulders of her engineers and the fact that you have agreed to address us on this occasion may be taken as an indication of your interest in our affairs and an acknowledgment of the importance of the role which we have to play.

I should also like to thank most sincerely my brother engineers for the great honour they have done me in electing me President. It is an honour which I greatly appreciate, and a responsibility which I do not underrate. I am well aware of the tasks which our members expect the President and the Council to accomplish during the coming year, and I am a little anxious about our ability to complete them successfully. I can, however, promise that we will give of our best and will endeavour to prove worthy of the confidence you have placed in us. I for my part will do all I can to maintain the dignity and reputation of my new office.

It has been the practice of incoming Presidents to deal in their Addresses with some aspect of the branch of engineering with which they are concerned, and I shall follow their example.

Bearing in mind that the Institution covers all forms of engineering, I propose to examine the role of the engineer — whether he be civil, electrical, mechanical, chemical, or military — in the defence of India. And so that I may not be accused of war-mongering or of dealing with a subject which is not of immediate concern, I shelter behind the fact that it is the business of soldiers to consider what the conduct of war may involve and in their planning to take a somewhat gloomy view of the wisdom of man in relation to his own affairs. In short, to plan for the worst and to hope for the best. I shall begin by sketching the subject broadly and then focus your attention on the particular problems which most concern the Corps of Military Engineers with which I am intimately connected.

Development of industry

War has for ages been a matter of men and machines. Thanks to the scientist and the engineer, machines have greatly increased in complexity and power, and war has reached a stage when the strain on man would appear to have reached breaking point. In these circumstances no nation can defend itself successfully unless its morale is high and its people are prepared to fight to the utmost for their liberty and way of life. Here the engineer in India has at once a clear and important role to play — in peacetime by his technical knowledge and skill to further to the utmost the economic and material welfare of the nation. The connection may not appear immediately obvious but it is true that every increase in the country's material wellbeing makes the task of defence easier. This process of increasing industrialization and economic development is not likely to be a smooth and easy one, and many of our young engineers who are now entering the profession may experience considerable difficulty and frustration before a stage is reached when there is satisfying and profitable work for all. The realization that he is playing some part, however modest. in the fight against poverty and want, and towards the greater security of his country, should spur the engineer to greater effort, and be of some consolation to him in times of difficulty.

Until industrialization has made further considerable progress. India is at a disadvantage in that she has to purchase from outside sources equipment essential to her defence. Every engineer who by his technical knowledge and skill and his industry and determination contributes to the development of India's industrial potential is contributing directly to her defence.

Development of Service equipment

Service armaments and equipment cover a wide range of items. Some are articles of everyday use or with slight modifications find themselves included in military equipment tables. Naturally the more the Services can make their requirements coincide with what is normally manufactured in the country the better. Service engineers should develop an awareness of what is possible in industry and a knowledge of the consequences of making special demands on it, and the civilian engineer and the industrialist should make an effort to take into account the requirements of the Services, and where possible develop articles intended purely for civilian use along lines which would make them acceptable to the Services.

Other equipment and armaments are of no use in the civil market, and their development and production confronts the Defence Services with many difficult problems. It is for the General Staff to lay down a policy: to state in general terms the nature of the equipment it requires. Nothing would appear to be easier! But General Staffs hitch their wagons to a star and are apt to consider the advice of their Technical Development Staffs as of the earth, earthy. It is not always easy to persuade the Staff that an equipment bridge capable of taking loads of the order of 100 tons over spans of 400 or 500 feet using alloys light enough to enable these spans to be dropped into position by helicopters is not yet feasible, and there is inevitably much debate before a decision on policy is reached.

It is then for the Arm or Service concerned to translate this general requirement into language which makes clear to the designer the special service limitations within which he must work. It is. for example, useless to produce a sensitive and powerful wireless set if it is not robust enough to stand up to the normal handling it will receive under active service conditions. There will follow months and even years of close collaboration and effort between the user and the designer before a pilot model likely to meet requirements is produced. This must then be subjected to long and carefully regulated troop trials designed to bring out every weakness which may develop in the field. All through this process the designer must think continually in terms of production both in peace and in war, until finally a stage is reached when an equipment suitable for use in battle is ready to be produced in quantity. The process is a tedious one extending over five to ten years and industrialists in India are often impatient of the delays it appears to involve. There is then a difficult choice to make. Is tooling up with one or two trial orders sufficient, or should the item go into production at once? This latter means heavy expenditure in manufacture, transportation, care and maintenance, and storage, and yet it is often the only way to discover all the snags.

This process is going on continually for many different equipment and much of this effort is in competition with purely civilian needs for the limited economic and industrial resources of the country. It will be realized that only by the most careful cooperation and understanding between all those who influence the production of armaments and equipment can solutions in the best interest of the country as a whole be reached. Here is a field in which engineers in and out of the Services must understand one another's problems and difficulties and seek to collaborate.

In recent years much progress has been made along these lines. India has had a Technical Development Directorate for many years, and her ordnance factories are well equipped and capable of turning out a wide range of armaments. Committees at a high level screen defence requirements carefully to make sure that equipment which can be developed in the country are not ordered from abroad, and close touch is kept with scientific development through the Defence Science Organization. The process is however a very complex one, vital to defence. and its implications should be understood by all those who are concerned with the defence of the country.

The engineers' task in war

Modern war affects everyone in the nation, and my brother engineers may take it that should it unfortunately come to India it will add considerably to their tasks. Some will find themselves in the uniform of one or other of the Services, thereby reducing the number who remain in civil life to contend with greatly increased responsibilities. Industry will have to be keyed immediately to the production of armaments. Clearly, plans for a rapid changeover should exist in peace or there will be dangerous delays. The strain on transportation systems will increase, and that at a time when maintenance and replacement will be exceedingly difficult. Civil defence which caters for the special needs of civilians who are subjected to the terrors of war will make heavy demands on the engineer. And wherever that war is fought, a great engineer effort must be expended in the rear areas on projects whose purpose is to maintain the forces, by land, sea, or air, at the highest Efficiency. It may be that India will not require to make an effort as vast as that made in the last world war but planning should be based on the worst probable conditions. It is for these reasons that in many countries there is now closer collaboration during peacetime between Service and civilian engineers. Only last month the Engineer-in-Chief of the War Office, London, Major-General Tuck. read a paper before the Institution of Civil Engineers on 'The Engineer Task in Future Wars' in which he gave as a contribution vital to success in war, the peacetime collaboration of military and civil engineers in engineer planning and organization and in the solution of many military problems by the latest technical developments.

Engineers in the Services

Modern defence forces depend for their vast power and ability to strike on engines — tens of thousands of them. Men exist in every branch of the Service to operate these engines and many of their officers are professional engineers in their own right. In the Army alone, many of the officers in the Corps of Signals are experts in electronics and telecommunication engineering, in the Corps of Electrical and Mechanical Engineers practically all of the officers are highly skilled and highly trained in the maintenance and repair of a vast range of weapons and vehicles and in the running of mechanical workshops, in the Armoured Corps and in the Supply and Transport Corps a proportion of officers attain a high degree of mechanical skill in the maintenance and running of specialist vehicles, and the artilleryman and infantryman are now equipped with a range of complicated weapons and vehicles which makes any officer with engineering skill of value to his Arm. And lastly and — I say it with pride — not least, there is the Corps of Military Engineers whose role in war is to apply engineer knowledge and engineer resources to the furtherance of the commander's plans; to assist the Army and at times the Navy and the Air Force to overcome every physical obstacle which may hold up the advance of our own forces whilst putting every possible obstacle in the path of the enemy's advance; to carry out those engineer tasks which will help the Army to fight, to move, and to live; and when necessary to fi$ht to accomplish these tasks.

All these Service engineers carry out tasks which are similar in many ways to those done by their opposite numbers in civilian life, but with one important difference. Engineering in peace is a matter of careful planning and the application of skill and knowledge to produce something to a definite specification. Whatever may be the conditions under which the work is carried out, and in directing the great sources of power in nature for the use and convenience of man, these conditions are often varied and difficult, yet the work to be completed is clearly defined. In war other considerations prevail. Time is always short: planning is often inadequate and must go on side by side with execution: events and conditions are never static: specialization is almost impossible: the engineer is in competition with his brother officers for transport, labour, and even space: and the enemy is continually seeking to upset his plans and destroy his work. Engineering in war is only a means to the end, which is victory in battle. The engineer in the Forces must be a soldier first, well versed in the art of war, but at the same time competent, though not necessarily highly specialized in the engineering which concerns his Arm. For this reason engineers in the Services are organized and trained to operate under active Service conditions, and so in peacetime are not always economically as efficient as organizations planned for specialized work.

The military engineer

The work of the military engineer covers a wide field of engineering: roads, bridges, airfields, railways, ports, water supply and lighting, fuel and water pipe lines, field defences and fortifications, mine warfare, bomb disposal, demolitions, workshops, local production, survey and map reproduction, and whatever unforeseen development may crop up. This latter is an important feature of our traditional responsibilities and one which makes it essential that the Corps of Engineers should always have a number of officers with the highest possible basic scientific and engineering training and the passion and opportunity to continue their studies and accumulate experience in time of peace. The Corps has in the past put its hand to a wide range of activities, and when these have developed sufficiently has shed them. Naval mines and torpedoes, signals, searchlights, sound ranging, trench mortars, chemical warfare, flame warfare, rockets, military transport, and even aircraft all began as engineer babies and there are obviously more babies yet to come.

It is sometimes said that as the military engineer has only to meet temporary requirements and to build structures which are not expected to last for long, his problems are simple and do not require any degree of engineering knowledge or skill. But the military engineer who imagines that scour is something which affects only the massive piers of his civilian confrere's bridges and will not affect equipment piers, or who imagines that because a runway is only likely to be required for a couple of months the specification can be very poor, or who decides that a railway bridge cannot be built across a river like the Rhine in 6.8 weeks because the proposed Ganga Bridge at Mokameh will take years to construct and cost crores of rupees, is not likely to go far in his profession. Moreover, the problems which are likely to confront him in the future are, in spite of the vast improvements in engineering techniques, likely to be even more difficult.

Engineer problems in future war

It will help to give an idea of these problems, if I mention some which are now causing us concern. It is never easy to predict the conditions under which a war will be fought. Writers on the subject can afford to be startlingly imaginative qualifying their prophesies in such a way that they can always claim to be right, but statesmen and soldiers who have to take action on the basis of estimates of future requirements have to be more careful about their predictions. Over-insurance can be very costly and may be dangerously wasteful: under-insurance may be disastrous. When, however, it can be stated, at a very high level, that an existing stockpile of atom bombs 'exceeds by many times the explosive equivalent of the total of all the bombs and all the shells that came from every plane and every gun in every theatre of war through all the years of World War II', engineers must work on the assumption that destruction will be on a considerably larger scale, and that the dispersion, alternative sites, overhead cover, and the general all-round flexibility which Army and Air commanders will require will add considerably not only to the magnitude of their tasks but also to their complexity.

Roads have always been a problem, particularly in mountainous and heavily forested country. Dispersion will add considerably to the mileage required in the forward areas and in the communication zones. In spite of the fact that many service vehicles have considerable cross-country capacity, the main stream of traffic tends to be confined to main roads and for periods becomes almost continuous, and the problem of maintaining surfaces and consolidating berms when the closing of parts of the road are out of the question, is a very considerable one. The solution appears to lie in devising a team of plant capable of moving at, say, 5 to 10 miles an hour and of spreading and consolidating a premix as it moves. Much is known about soil stabilization but much still remains to be done before we have solved the difficult problem of making roads quickly in undeveloped country.

Armoured and other vehicles are getting heavier and the existing Service bridges are no longer strong enough or wide enough to take them. The Service bridges recently erected across the Ganga at Allahabad took elephant processions and the fact that elephants were willing to walk over them is a measure not only of their strength but also of their stability and rigidity. Unfortunately it is not possible to go on adding further panels to the existing bridges and an entirely new structure is required. The existing members have reached the limit for man-handling and the problem is one of producing an equipment bridge capable of taking loads up to, say, 100 tons—a 60-ton tank carried on a transporter exceeds this load—using parts which can be assembled by mobile cranes. Even to prepare the qualitative requirements of such a bridge requires a considerable knowledge of the science of bridge designing.

An ideal solution would be a Service bridge which could be assembled well back from the river, out of range of artillery fire, and then be carried forward or pushed forward on tractors. The engineer need hardly be reminded that in the construction of such a bridge the approaches may possibly give him far greater. anxiety and call for far greater engineering resources than the bridge itself. Our present suspension bridge for use in the kind of country which borders India on the north-east can be transported to the site and erected in a few weeks and carries 40-ton loads over a gap of 400 ft. Can we rest content with this, or will a demand arise for longer spans?

Aircraft is becoming heavier and faster, and it is clear that the special steel planking, the wire mesh, and the pre-biturnenised hessian surfacing, used in the last war for temporary airfields and the repair and expansion of permanent airfields, are reaching the limit of their usefulness.

Concrete and similar surfacings are out of the question because of the time, labour and transport they require. Some form of cement soil stabilization may be the solution under certain climatic and soil conditions, but not in all.

It should be realized that the word 'temporary' used of an airfield applies more to the time for which it is likely to be required than to the service it is expected to give. Any one who has seen a squadron of fighters scrambling into the air will realize that dusty, bumpy, and insufficiently graded runways are not good enough. Engineers must recognize the fact that pilots are naturally exacting in their demands and liable to lose complete confidence in an airfield on which they have had one or two accidents.

Minefields have set the military engineer a whole series of problems: how to evolve a mine which is cheap to manufacture, safe to handle and transport, and which cannot easily be detected by existing mine detectors: how to overcome the fact that a minefield which is lethal to the enemy is just as liable to be lethal to our own troops advancing later: how to cross a minefield by using explosive blast, jet blast, or by some form of roller or plough which will work its way through the field without itself becoming a casualty: how to lay and conceal a minefield of considerable area by mechanical means. Some progress has been made in these problems but much remains to be done.

Bomb disposal has fallen to his lot. Constant research is needed to anticipate the type of bomb fuse and the particular delay mechanism and anti-handling device which an enemy may devise, and to improve methods of dealing with unexploded bombs. Warheads of guided, missiles such as the V1 and V2 used in the last war are likely to be more complicated in future, and some day it will fall to his lot to dismantle an atom bomb which has not gone off. Gas was not used in the last war, but he must remain alive to the problem of decontaminating large areas sprayed with mustard and other gases, and he must expect that in future wars more unpleasant gases may be used.

And to end with a small selection from his many problems, the military engineer must improve his existing visual aids to night work, find at least a partial solution to the problem of allaying dust, produce a plastic explosive which will retain its plasticity under all climatic conditions, improve his delay action firing and booby trap equipment, and find some suitable form of barbed wire which is easy to handle, difficult to cut, and which will not rust. These are problems which the civil, the electrical, the mechanical, and the chemical engineer can help him to solve. And fight to accomplish these tasks

Finally, he must if necessary fight in war to accomplish these tasks. The Corps of Engineers has done so in the past. The first awards for bravery in the Indian Army were given to the Bengal Engineer Group. The first V.C. of the last war was won by Colonel Bhagat of the Bombay Engineer Group; the first George Cross by Subedar Subramaniam of the Madras Engineer Group, and one of the first Param Vir Chakras, now the Army's highest decoration for valour, by Captain Rane. The Corps of Engineers can be relied on in future to fight whenever it IS necessary to accomplish its role in battle.

Assistance from the civilian engineer

Engineer tasks in future wars are likely to increase to such an extent that no country can afford to maintain in peace more than a very small proportion of the engineers which it will require in war. How is the gap to be bridged?

First, I suggest, by the closest possible liaison and cooperation between the engineers in the Forces and their brother engineers in civil life. In this way the Service engineer will keep in touch with developments which may have a bearing on his present and future problems and will know where to turn for specialist help when this is necessary. His opposite number in civil life will develop an awareness of the problems of defence and an outlook which will make it easier in war to mobilize and deploy the engineer resources of the whole nation. In one respect a good start has been made towards achieving this liaison, for the Council has given military engineers every encouragement to become Corporate Members of the Institution and so to keep in touch with their opposite numbers.

Secondly, by ensuring that the various Territorial and Auxiliary units raised in the country are officered by the best available civilian engineers and are given every encouragement. It is sometimes asked why some of these technical units are required in India. Could not, for example, the Railway units be done away with and the existing Railway staff in a threatened area be put into uniform on the outbreak of war, particularly as this plan was adopted in Assam and Bengal in the last war? The plan adopted was very expensive in money and in effort and it was never put to the test of war. It would probably then have broken down, for when armies clash there is always a large battle area in which unorganized personnel cannot live or work. Conditions there are such that men must be organized into units not only for administrative purposes but for their own defence.

The solution, which has been tried out successfully in war, is that the Armed Forces in peace should include a small sample cadre of the units best fitted to carry out the particular engineering work in the battle area. The bulk of these units should be maintained on a Territorial or Auxiliary basis so that they may do some military training in peace and operate as fully mobilized technical units in war. They play an important role in defence and their efficiency is a matter of considerable importance.

Thirdly, by filling the reserve of officers with the best possible material: engineers who are willing in peace to give of their leisure and to join up at once on the outbreak of war.

Fourthly, by helping in the various schemes which will from time to time be introduced for giving military officers experience and training on peacetime projects and in engineering works. Inevitably senior engineer officers will be called on to carry heavy responsibilities in war and they must be given experience and training for this beforehand. We are not likely to return to the system by which large numbers of military officers were permanently seconded to the Railways, the P.W.D., and other engineering services, but it is in the best interests of the defence of the country that there should be ample opportunity for military engineers to develop their skill and confidence in time of peace. The American Army attributes the brilliant record of its Corps of Engineers, both as an organization and as individuals, to the excellent training and experience they have had on large river and harbour projects in peace. A possible suggestion is that India should have a General Reserve Engineering Force which would be employed on large projects in time of peace and be available to switch over readily to defence in case of need.

Fifthly, by cooperating to produce really effective war plans for the changeover of industry from peace to war.

Engineers generally in India

I have stressed the fact that there is a difference between the purpose of engineering in peace and of engineering in war. I hope I have not given the impression that there should be any vital difference in the outlook between engineers in the Services and their colleagues in civil life. In war, events are never static and the engineer will continually find that many of his most cherished projects are curtailed or come to naught, and he has therefore to cultivate a certain mental toughness and to accept frustration, delay and disappointment with equanimity. He will be called on to advise as to the engineering consequences of military plans, and his advice must be helpful, frank and fearless. He must foresee the engineering requirements of the force, plan prudently and intelligently, and inspire confidence in those with whom he works. He must not be too proud to ask for expert advice and not so gullible as always to take it. He must resist every attempt to dissipate engineer effort or resources. And above all, he must be obsessed with a strong feeling of the urgency of his work and have the power to communicate this urgency to those who work with him. I put it to you that there is a need for urgency in the economic and industrial development of India at the present moment, and that this war against poverty and want calls for exactly the same outlook and qualities from all her engineers, whether they be in the Defence Services or outside them, in uniform or in mufti.

The Institution of Engineers

I turn for a moment to the affairs of our Institution. It is the only recognized body representative of the whole engineering profession in India, and its members include engineers of all categories now practising in the country. It is not an association formed to further the interests of its members. Its object is the promotion and advancement of the science, practice and business of engineering in all its branches, and the exacting test of its success is its value to the public at large. Its membership has increased markedly since 1947 and this increase is continuing.

It suffers, however, from one marked disadvantage. It is, as at present constituted, working under a Royal Charter granted to it in 1935, and no change can be made in any of its Bye-laws without reference to the Privy Council in London. This is a rather slow process, unsuited to present day conditions. The profession in India is growing rapidly both in numbers and diversity, and it is obvious that our Bye-laws require. considerable revision and that revision will have to be done from time to time in order to keep pace with further developments.

For this reason, we have proposed to Government that we should surrender our Charter, and in its place be granted Statutory Recognition as an Institution authorized, as at present, 'to promote the general advancement of engineering and engineering science and their application in India and to facilitate the exchange of information and ideas on those subjects': to undertake exactly the same responsibilities and duties to the public and to our members as we now undertake, and to enjoy the same privileges.

It has been suggested that India should, as in other countries, have separate Institutions for the principal branches of engineering, and indeed some professional engineers have already set up separate organizations of their own. I do not believe that this development is in the right direction. Institutions, if they are to be effective in India, must have strong local centres in at least a dozen places spread over the country and these centres require a considerable administrative set-up if they are to fulfil their purpose. Our Institution, in spite of its resources and age, finds this exceedingly difficult: smaller institutions must find it impossible for very many years to come. I concede that in the past our Institution was slow in recognizing the growing importance of certain branches of the profession, and somewhat conservative in amending its constitution and bye-laws to meet these developments. We are alive to this now, and one of our first considerations, after we have received Statutory Recognition, will be to ensure that all forms of engineering are equally provided for.

There are other reasons why a single Institution is in the best interests of the country and the profession. Engineering is now very interdependent arid the dividing line between the various branches is vague. Though every engineer tends to become more specialized in his own line, he is nevertheless forced to have a general idea of what is happening in three or four branches. We can no longer shut ourselves up in watertight compartments. Our contacts too with engineers in other countries tend to increase. India has continually to be represented abroad by delegates from the different branches of the profession. Is it not better that one central body, having the pooled resources and experiences of all branches. should organize these delegations, and when necessary act as the host body to visiting delegations of engineers from abroad ?

We are late in the field in many sections of engineering and I doubt at, this juncture if it is possible for us to build up a really comprehensive Central Technical Library. But a powerful Institution could at least develop a first rate Information Bureau where every engineer would get the best possible advice as to where he could find the information he wants, and who, from the point of view of Indian conditions, are the best authorities on his problem. Many engineers in India are at present forced to seek this assistance from institutions abroad.

Ultimately such an Institution could develop other important services of value to the community. For example, by taking more active steps to promote efficient, just and honourable dealings in engineering and in suppressing malpractices, by evolving equitable systems of arbitration and nominating suitable persons, by assisting in the build-up of bodies of consulting engineers in India, by assisting in the development of codes of procedure, and by playing a more active part in professional and technical education in the country.

I am convinced .that the greatest good to the profession and indirectly to the country as a whole lies in a determination on the part of all professional engineers to pool their resources in organizations, buildings, funds and effort, so as to build up one really worthwhile Institution which would be in a position to disseminate professional knowledge rapidly and on a wide scale, and worthily to render to its members and to the country generally all those other services and responsibilities listed in our present Charter. If we make this our aim and devote our energies to this end, we may confidently hope that Governments and all those interested in the development and progress of engineering in India will give us all possible aid.

Registration of Engineers

There is one further problem on which I should touch — the Registration of Engineers. There is no doubt that individuals claiming to enjoy rather high sounding titles of an engineering nature are in a position to deceive the public, and that men whose professional knowledge and experience is meagre have on occasions been consulted with unfortunate results. Nevertheless, engineering covers a very wide field of human effort, and it is difficult to expect that Registration, however competently done, will fit the engineer so registered to undertake all forms of engineering work with satisfaction to his client. It may be that it, is the duty of the profession to educate the public to realize that greater discrimination is necessary in the selection of engineers for important engineering. Government has asked for our views on this subject and we shall examine it from the standpoint of the interests of the country at large. If the effort which it involves is worthwhile in the wider interests of the public we shall recommend it and put forward proposals as to how it could adequately be done. If it is not likely to serve this useful purpose, we shall give our reasons for not recommending it.

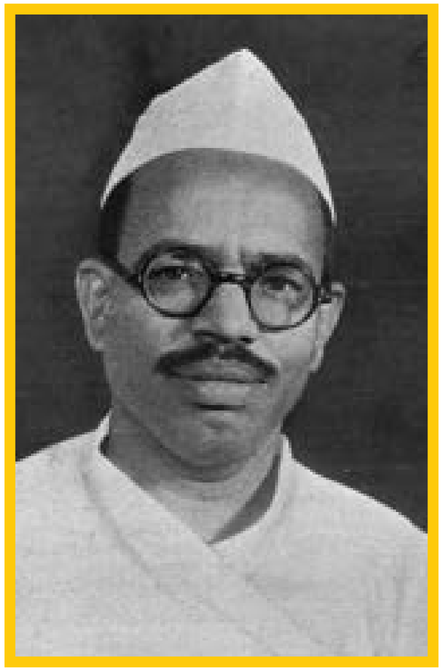
Conclusion

Recently in Delhi we have had at our Local Centre a very encouraging address from the President in which he summarized the position of engineers in India today.

The country has before it a large programme of all-round development — in railways, in industry, in housing, in health engineering, in hydel and thermal works. In no sphere of constructive effort can there be progress without the help of able and efficient engineers possessing integrity and drive. Great hopes are entertained of us, so that poverty may be banished and India once again becomes a land of plenty.

I do not think that as engineers we claim to be a peculiar class, apart from the rest of the nation. We too have our difficulties and frustrations and our share — but not more than our share — of the weaknesses to which all human nature is heir. But we have too our full share of those qualities which men greatly admire — of pride in our work, of devotion to duty, of patriotism, and of selflessness. These qualities, Sir, we place unreservedly at the country's service and at the service of all those who bear the heavy burden of office.

Jai Hind.



Shri S B Joshi

B.E., M.I.E

President 1954-55

Presidential Address

Sardar Swaran Singh, Ladies and Gentlemen,

1.1. I deeply appreciate the honour which your Council has done me by electing me as President of the Institution for the coming year. With your cooperation and goodwillI will make a humble effort to maintain the traditions handed down by my predecessors and to be of service to the Institution and the profession.

1.2. During the recent past we have done a magnificent job in the execution of our share of the First Five Year Plan. Considerable progress has been made in hydroelectric and irrigation projects, river training and flood control works, roads, railways, bridges, building of ports, providing water supply and sanitary arrangements to urban and suburban areas, town and country planning, community projects, housing schemes, manufacture of oil engines, manufacture of locomotives and aircraft, pumps, automobiles, machine tools, electrical goods, increasing output of essential commodities like steel and cement, etc. Hydro-dynamic research stations, road research stations, building research stations, laboratories and test houses are thirsting for expansion in view of the increasing number of problems tackled by them. Many engineering colleges and technical institutions have been opened. In fact, so varied are the nation-building activities with which engineers are connected that it is almost impossible to make an exhaustive list. Little wonder that we are so much in the public mind that hardly a day passes without some august person criticising the engineer in the context of the execution of the First Five Year Plan. There is obviously greater scope for criticism of the one who builds than of the one who does not. Success of the nation' s plans depends to a large extent on the quality of our performance. We have a unique opportunity of service to society. We have done good work in the past and we shall do better in the future. We must either grow or decay. We cannot stand still. We must give up any lingering conservatism in our methods and show a fresh outlook to problems that face us.

1.3. Being too involved in cusecs, kilowatts and bending moments in our day-to-day work, we are likely to ignore the rapid ideological revolution in the structure of society that is going on before our eyes. We must realize that we are not mere rice soldiers — mere tools for putting brick upon brick. The impact of the ideological revolution on our activities will be heavy. We will be able to do our job efficiently when we understand and appreciate the purpose behind it — the ultimate picture of society that is aimed at. Parliament has declared its intention to build a socialist* pattern of society. Both in the process of building a socialist pattern of society and in the administration of the resulting machinery of the State, engineers will have to play a vital part. Engineers come in direct contact with labour. They will initiate, plan, execute and run State industries. Strategic control of private engineering industries will be through engineers.

**The word 'socialist' is used in the same sense as 'socialistic'.*

They will, therefore, have a very heavy responsibility to bear in building up the socialist pattern of society.

2. Responsibilities of engineers in building up a socialist pattern of society

2.1. We must therefore try to understand what is socialism and visualize the role of the engineer in building up and running the machinery of socialist India. The word 'socialism' is nobody's patent. It is not defined by statute. It is a natural phase in the evolution of society in which man is being progressively freed from the tyranny, overlordship or exploitation by another through the instrumentality of his surplus wealth, cunning, power or social position. Abolition of the slave trade, the emancipation of women, the struggle against colonialism and its consequent exploitation of industrially backward areas by highly industrialized countries, and, lastly, the struggle against the exploitation of labour and accumulation of wealth in the hands of a few in capitalistic society, are all stages in the evolution of society towards a State assuring equal opportunities and social justice to all. It is held by eminent thinkers that some sort of socialist central planning for the common good is a convenient means towards the attainment of the above objectives. Central planning, socialization of key industries, and strategic control of private enterprise are the external manifestations of formal socialism. Purists may object to the use of the term 'socialism' where all the instruments of production are not owned by the State. But it will be rational to understand socialism in terms of the objectives rather than the means. Full-fledged socialization may not necessarily be an essential ingredient of a socialist state, if its objectives of full employment, equality of opportunity, and social justice can be achieved otherwise. Full-fledged socialization has also its own evils. Centralization, loss of efficiency, curb on personal liberty, loss of variety in colour and mass with consequent loss of beauty in the social structure, are some of the risks of full-fledged socialization. Moreover, human energy dissipated in the pursuit of wealth may find an alternative vent in the practice of cruelty, reckless pursuit of power and authority, and other forms of self-aggrandizement.

2.2. It is interesting to study the history of economic thought in the search for methods of stabilizing employment. Such study has a particular significance to engineers. They will find that the genesis of the Public Works Department was the desire of the State not only to provide amenities to the public but also to provide a means of stabilizing employment. Involuntary unemployment is caused by industrial fluctuations. The State has to meet the social costs of maintaining the unemployed. Economists have been suggesting several remedies since the last two hundred years for stabilizing employment. As early as 1723, Mandeville ridiculed the doctrine of thrift and advocated expenditure as a means of prosperity. In his famous Fable of the Bees* he describes the plight of a prosperous community in which all citizens suddenly take into their heads to abandon luxurious living in the interest of saving. He concludes with a moral that expenditure on public works is the means of giving employment to everyone and making a nation happy.

*’*For 'twas not only they that went,*
By whom vast sums were yearly spent;
But multitudes that lived on them,
Were daily forc'd to do the same,

... ...

Mandeville's ideas were condemned by moralists and economists of his time. They had such great faith in thrift that they could not afford hospitals, open spaces, noble buildings — not to speak of the extravagance of music and drama. As early as 1889, Hobson and Mummery again maintained that excessive saving was responsible for under-employment of capital and labour in days of bad trade. Hobson almost suffered excommunication from the ranks of the learned at London and Oxford for his irrational theories! Silvio Gesell, a German economist, attacked the money rate of interest as the chief obstacle to the growth of capital and consequently to the means of providing full employment. According to him the prime necessity was to reduce the money rate of interest by causing money to incur carrying costs along the path of time and space. Gesell advocated a sort of anti-Marxian socialism, a reaction against laissez-jaire, built on theoretical foundations totally unlike those of Marx in being based on a repudiation instead of an acceptance of the classical hypothesis and on an unfettering of competition instead of its abolition. He proposed that 'currency notes' would retain their value by being stamped each month with stamps purchased at a post office.

2.3. It will be seen that full employment conditions can be achieved partially by operating a monetary policy of money rate of interest and taxation so that the functionless investor does not get a bonus, and intelligence and skill are used for the common good on reasonable terms; and partially by having a large sector of public works in the hands of the State by comprehensive socialization of investment. We engineers will be interested in appreciating the origin of the Public Works Department. State undertakings in public works can operate as a flywheel to absorb the labour energy released by fluctuations in the industrial output. The building of the Taj Mahal and other monumental structures must have helped the maintenance of full employment. The objectives of full employment, equality of opportunity, and social justice can be achieved without taking the risks of full-fledged state socialism. A socialist 'monetary policy' and a large measure of socialization, leaving a wide field for exercise of private initiative and responsibility, represent a healthy trend in the socialist movement. We may as well call it Neo-Socialism. This peaceful solution is commended by J. M. Keynes in his 'General Theory of Employment, Interest and Money',*

The Building Trade is quite destroy'd,
Artificers are not employed;
No limner for his art is fam'd,
Stone-cutters, carvers are not nam'd,
... .
Bare virtue can't make nations live,
In splendour, They that would revive
A Golden Age, must be as free,
For acorns as for honesty.’

'The great art to make a nation happy, and what we call flourishing, consists in giving everybody an opportunity of being employed; which to compass, let a Government's first care be to promote as great a variety of manufactures, arts and handicrafts as human wit can invent; and the second to encourage agriculture and fishery in all their branches, that the whole earth may be forced to exert itself as well as Man. It is from this policy and not from the trifling regulations of lavishness and frugality that the greatness and

felicity of nations must be expected; for let the value of gold and silver rise or fall, the enjoyment of all societies will ever depend upon the fruits of the earth and the labour of the people; both which joined together are a more certain, a more inexhaustible, and a more real treasure than the gold of Brazil or the silver of Potosi.' (Mandeville. Reproduced from 'The General Theory of Employment.. Interest and Money' by J, M. Keynes, p, 360-361)

**'The central controls necessary to ensure full employment will, of course, involve a large extension of the traditional functions of government. Furthermore, the modern classical theory has itself called attention to various conditions in which the free play of economic forces may need to be curbed or guided. But there will still remain a wide field for the exercise of private initiative and responsibility. Within this field the traditional advantages of individualism will still hold good.*

Let us stop for a moment to remind ourselves what these advantages are. They are partly advantages of efficiency-the advantages of decentralization and of the play of self-interest. The advantage to efficiency of the decentralization of decisions and of individual responsibility is even greater, perhaps, than the nineteenth century supposed; and the reaction against the appeal to self-interest may have gone too far. But, above all, individualism, if it can be purged of its defects and its abuses, is the best safeguard of personal liberty in the sense that, compared with any other system, it greatly widens the field for the exercise of personal choice. It is also the best safeguard of the variety of life, which emerges precisely from this extended field of personal choice, and the loss of which is the greatest of all the losses of the homogeneous or totalitarian State.

For this variety preserves the traditions which embody the most secure and successful choices of former generations; it colours the present with the diversification of its fancy; and, being the handmaid of experiment as well as of tradition and of fancy, it is the most powerful instrument to better the future.

Whilst, therefore, the enlargement of the functions of government, involved in the task of adjusting to one another the propensity to consume and the inducement to invest, would seem to a nineteenth century publicist or to a contemporary American financier to be a terrific encroachment on individualism, I defend it, on the contrary, both as the only practicable means of avoiding the destruction of existing economic forms in their entirety and as the condition of the successful functioning of individual initiative

Prof. Pigou, though not belonging to Keynes' school of thought, nicely describes his ideas about the gradual introduction of socialization in the early stages.†

†*'If then, it were in the writer's power to direct his country's destiny, he would accept, for the time being, the general structure of capitalism; but he would modify it gradually, He would use the weapon of graduated death duties and graduated income tax, not merely as instruments of revenue, but with the deliberate purpose of diminishing the glaring inequalities of fortune and opportunity which deface our present civilisation. He would take a leaf from the book. of Soviet Russia and remember that the most important investment of all is investment in the health. intelligence and character of the people. To advocate 'economy' in this field would. under his government. be a criminal offence. All industries affected with a public interest. or capable of wielding monopoly power. he would subject at least to public supervision and control. Some of them. certainly the manufacture of armaments. probably the coal industry, possibly the railways, he would nationalize. not of course on the pattern of the Post Office but through public boards or commissions. The Bank of England he would make in name what it is already in effect — a public institution; with instructions to use its power to mitigate, so far as may be, violent fluctuations in industry and employment. If all went well. further steps towards nationalization of important industries would be taken by degrees. In controlling and developing these nationalized industries. the central government would inevitably need to 'plan' an appropriate allocation for a large part of th country's annual investment in new capital. When these things had been accomplished. the writer would consider his period of office at an end and would surrender the reins of government. In his political testament he would recommend his successor also to follow the path of gradualness — to mould and transform. not violently to uproot; but he would add, in large capitals, a final sentence, that gradualness implies action and is not a polite name for standing still.*

2.4. I have made a humble attempt to understand the implications of socialism that is being introduced in India. Whether it will take the form of State socialism (giving out during the process heat energy in the form of violence and other anti-social consequences) or whether it will be a sort of Neo-Socialism brought about peacefully and gradually, depends not on the will of *one man* but on the extent and the quality of the cooperation of Parliament, the public executive, private enterprise and the people in the achievement of the common objective. It is, therefore, the duty of all of us, engineers and others, whether engaged in the private or the public sector, to put the utmost of our intelligence and labour towards the establishment of an economic social order which has for its aim peace in the land, freedom of the individual, and equality and justice to all citizens. Unrestrained legislation, and incompetent executive misusing its delegated authority will lead to chaos and misery arising from regimentation of the people under State capitalism coupled with bureaucratic despotism.

3. Some illustrative discussion of the new outlook

3.1. A socialist pattern of society is not merely an economic order of society; It IS a theory of life to which we engineers are not accustomed to live. To be true to the spirit of the socialist pattern of society we will have to change our methods of dealing with men and matters. Changes in the P.W.D. rules and regulations, office routine, methods of recruitment and promotion, etc. are also called for. On this background I will discuss by way of illustration the following aspects of a socialist pattern of society which have a bearing on engineers and engineering.

1. Dignity of man

(a) Spread of education.

(b) Importance of character in the citizen and the services with particular reference to the charge of corruption against engineers.

(c) Recognition of the dignity of work with particular reference to some human aspects of employment.

(d) Engineers must be rational, scientific and self-reliant in facing their problems.

2. Coordination between the private and the public sector

(a) Integration between the private and the public sector.

(b) Pilot schemes of socialized industries in competition with the private sector.

(c) Using the talent available in practising engineers for public works.

3. Responsibilities of the State executive

(a) Recruitment and promotion in the technical departments with special reference to the controversy regarding posts of Secretaries and like posts.

(b) Dealing with contractors must be fair and just.

4. Role of the Institution of Engineers

The Institution of Engineers is the pulse of engineering activity m the country.

4. Preservation of the dignity of man

4.1. In a socialist pattern of society, education, of course, must receive the first attention. On the subject of education so much has been said by so many. We have had the Sargent Report, the Report of the University Education Commission, and the Report of the Secondary Education Commission. These reports are excellent in themselves, but I have a humble feeling that they do not go to the root of the question. It is unfortunate that there is no educational research giving statistical information about student environment, relation between their socio-economic condition and their achievements, relation of intelligence to educational opportunity, aim of education and place of utilitarianism in education at all stages, question papers, text-books, examinations, and so forth. In the absence of such useful data, the above reports have lost any realistic value. For instance, the chapter on engineering education in the University Education Commission's report is neither sufficiently accurate in its facts nor is it inspiring in its approach and conclusions. In the part dealing with the history of engineering education it has nothing significant to say about ancient engineering in India. It is dismissed as a mere art of the craftsman and the artificer! The report has made a remarkable diagnosis of the defects in the engineering education in India.* 'The structure of engineering education should be such that when opportunities occur it will be possible for the country or the industries to collect requisite personnel from technicians to Executive Engineers, to turn the discovery to use within as short a period as possible. Such a set-up of engineering education existed in Germany and exists in the U.S.A., but not in the United Kingdom, of which the Indian system was for long a bad and obsolete copy.' Engineers will be interested to note one further discovery by the University Commission.† 'Though India has hundreds of cities, designs for city water supplies or of city sewage systems have been rarely done by Indian engineers. A large part of the planning and designing formerly was made, usually at very high cost, by foreign firms. The same has been the case with designs of hundreds of bridges, railway lines and factories.' The report of the Secondary Education Commission is equally unrealistic. The fault is not with the respective commissions. They have not got available to them factual research on educational conditions in the country on which to base their reports. If the educational aspects are collected by a random sample and analyzed we will be face to face with problems from which we are trying to escape. The problem is how to transform schools founded under the shadow of an oligarchic and competitive order into schools suited to the needs and generous temper of an emerging democratic society. If equality of opportunity implied in a socialist pattern of society is to be translated into practice, the reports of the University Education Commission and the Secondary Education Commission will not be very helpful.†† Implementation of these reports under the present set-up will neither cater for quality nor for quantity. It' is not possible to have a long discourse on education here. I will state what appear to me the important factors requiring consideration.

††*This is what Mr. J. A. Lauwerys, Reader in Education, University of London, has to say about these reports in his introduction to 'Educational Reconstruction' by C. Black.*

'It cannot be too clearly understood or widely known that many (certainly not all) of these reports do not represent expert educational opinion. Indeed, the recommendations made and opinions expressed often run Rat opposite to the views of the experts.

So much is this the case that research workers in education sometimes look through the reports for phrases beginning 'it is certain that ...' or 'as is well known ...' in the confident hope that here precisely will be found doubtful statements unsubstantiated by evidence or popular fallacies which research could easily expose.

**p. 223*

†*p.239*

(1) The load of subjects at all stages from primary to university is too heavy. This is due to the belief that everything that a student should know to earn a living or to become a citizen must be taught to him in the school or the college by a set curriculum. This is a static view of education. Beyond a few basic subjects most other knowledge should be left to the choice, liking or urge of the students-in the form of voluntary subjects and extra-curricular activities like debating unions, students' magazines, informative lectures, music and drama, sports, excursions, libraries, museums, exhibitions, non-political newspapers, etc.

This distinction between 'reproduction' knowledge and 'recognition' knowledge is recognized by modern progressive educationists.* This distinction should be extended to engineering colleges and technical institutions.

(2) Men in charge of the existing educational institutions, schools, colleges and universities have a disinclination for change to methods to which they are not accustomed. They are already blamed for their poor performance in relation to the performance of educational institutions abroad. They are naturally nervous to agree to changes which in the initial stages may bring the standards lower than those accepted in educational circles. Just at the time when they would have shown some good results they were faced with the task of catering for almost five to six

times the number of students for which the existing institutions were intended. Institutions are overcrowded; teachers are overworked; they are burdened with administrative work in addition to academic work; teachers generally are not paid adequately; new theories of education and new courses are thrust upon these institutions in rapid succession. The institutions do not get any respite to stabilize themselves and to show results. I feel that the only way out is to create a parallel and independent structure .of education to cater for the masses by way of *Janata* schools and colleges. These *Janata* schools and colleges can be run on unorthodox lines, new experiments for spreading general and technical education on mass scale can be tried without in any way affecting the structure of the existing educational system. As the new institutions show results by their performance, the old ones will automatically adapt themselves to new standards and methods that will evolve by trial and error in the *Janata* schools and colleges. The *Janata* schools and colleges can be free from the burden of examination on a mass scale by making them autonomous. They can also be free from too much of democracy in the working of committees and boards.

This matter is vastly important because, far too often, these impressive looking documents lean so far backwards in the effort to conciliate conservative interests as to become reactionary.

** H. C. Stead observes 'It would appear that a legitimate division can be drawn between what is known as 'recognition' knowledge and 'reproduction' knowledge. At present all subjects are taught as if education were concerned only with reproduction knowledge-knowledge to be reproduced. No doubt this is on account of the examination system, together with a view of education for the masses as having a utilitarian value only. But the kind of scientific knowledge and social knowledge that the citizen of today needs is that more correctly described as 'recognition' knowledge, i.e., the ability to recognise the nature and relationship of facts with which he is brought into contact. This knowledge can be given in a wider field if no effort is made to make it all reproduction knowledge. This distinction is one which will have to be considered in devising a modern curriculum. ('Content of Education' by H. C. Stead, Fabian Quarterly, January 1943)*

It is also not necessary to have uniform types of these institutions throughout the country. There can be lot of scope for trying different methods of education. Semi-Government and private institutions can be encouraged with liberal grants from Government. The field of these institutions can cover primary education as well as higher education in arts, technology and medicine. Many of these schools may be on the lines of the Folk High Schools in Denmark, Norway and Sweden which have proved a great success during the last one hundred years. These high schools have no respect for examinations and books.*

** N. F. S. Grundtvig. the prophetic leader of the Folk Schools and Colleges. declared. 'Dead is the letter. though it be written by the hands of angels with stars for pen and dead is all book learning that does not awaken its response in the mind of the reader. fusing life with his life. Killing and destroying to the soul are not only mathematics and grammar but all intense mental strain imposed upon the child before brain and body are developed-and before a natural desire to be enlightened has arisen: ('Education in Democracy' by John Christmas Maller and Katherine Watson. p. 24)*

In reply to the pressure from the Minister of Education to introduce examinations. the Principal of the Folk High shools replied:

'The school is well aware of the value of accurate knowledge and the development of reasoning powers ... Learning here is for life and not for schooling. We wish our students to leave us with a desire 10 take part in the work of life. the spiritual not less than the temporal. and with discernment to use what life offers. What they lack in knowledge they will know how to gain and their reasoning powers will receive the development of which they are capable. But such a mode of instruction is not suitable for examination: (ibid. p. 27)

(3) Regional language or Hindustani should be introduced as the medium of instruction at least in some of the subjects to begin with. Resistance of some of the universities to State interference loses its force when they do not act themselves. Nothing can be more perverse in India than the teaching of Sanskrit with English as the medium of instruction. In any case, technical education will not reach the masses if the medium of instruction in the technical schools and institutions is not changed from English to the regional languages.

(4) Two aspects of research must be appreciated. One is the attitude of mind of both the teacher and the taught towards a subject. It impels them to question 'Why?', to test the truth by an experiment or investigation, to try a different line of approach. The other is the utilitarian aspect of applied research. The latter makes use of the former in industrial application. Research like poetry is a spontaneous outburst of powerful thought. Planning research is like planning poetry. The method of submitting a problem for approval to Delhi and securing a grant is against the spirit of a research mind. Let an initial grant be given and let there be increasing allotments from year to year on the basis of past performance.

(5) There is nothing fundamentally wrong with the teachers and the taught. The fault lies with the leadership which is trying to do too much in satisfying simultaneously the requirements of pure education and the utilitarian encroachment of Government and industries in the field of education. Teachers and students are easy scapegoats to explain away the failure of an intrinsically incorrect system.

4.2. Character

Common folk in India are very honest. There are a few cases of loss of character and licence amongst such higher classes as have acquired power and wealth only recently. No class is immune from the dishonest type. Engineers are, however, subjected to greater criticism than others for their alleged lapses. We do not like to justify our lapses by pointing out those of others. In a socialist pattern of society, engineers, the bulk of whom are in Government service, will wield great power and influence and will be in charge of money-spending departments. It is gratifying to note that a large number of engineers — from bottom to top — have a reputation for honesty and integrity. It is our duty to resist external forces which are likely to adversely affect the morale of engineers. The most disturbing force is the attitude of the authorities — the legislators and the administrators. In Parliament, on the public platform, and in engineering conferences, they make direct or indirect suggestions questioning the honesty and integrity of engineers, Do the politicians and administrators believe that they can get efficient and honest work from engineers by abuse, threats, criminal prosecution, and by suspecting their actions? Engineers can work efficiently if Government has faith in them.

I am tempted here to quote a few lines from Field-Marshal Montgomery's address to his troops. 'I wanted to come here today so that we could get to know one another, so that I could have a look at you and you could have a look at me — if you think that's worth doing. We have got to go off and do a job together very soon now, you and I, and we must have confidence in each other. And now that I have seen you I have complete confidence — complete confidence — absolutely complete confidence. And you must have confidence in me.'

Just imagine, instead. Montgomery addressing his soldiers in the following vein: 'you have been at the job for a long time. I can wait no more. I am disgusted with the way you are doing your work. While I am satisfied that your officers are loyal and dutiful I cannot say the same about the ranks. I have reports that many of you are cowards and traitors. I have given orders to my reliable informants to shoot such men on the spot. I hope you will take heed of this warning and do your job with loyalty and zeal.' The disastrous results of such an address by an army general to the soldiers has only to be imagined. The disastrous results of such treatment to the engineers of the country are obvious.

The average engineer has to forget the science of engineering and has to devote most of his time in guarding against an audit remark; the honest and the competent type incur the displeasure of the authorities and suffer from frustration.

No one can dispute that honesty and integrity alone can build a nation. Some of the methods of raising the moral level of the services would be :

(a) The cry against corruption and nepotism will be silenced if the accusers resort to introspection. Example is better than precept. The higher the position of a man the higher should the standard of morality be applied to him. The subtle influence of power and position in unconsciously bringing undue benefits or easy justice to a person in authority, his children, friends and relatives or to those belonging to his class or province has a demoralizing effect on other people who are not so fortunate.

(b) The following suggestion of Mr. Gorwala has been ignored in many States in the selection of officers in positions of responsibility or influence.

'There is, in this matter of corruption, one clear criterion which can be of great assistance in assessing the possibility or otherwise of its existence. Reputation' can be taken as almost conclusive. It may be said of an officer w;ho has not that particular fault, that he is harsh or rude or lazy, but it may be laid down almost as a rule that, over a period, it will not be said of an officer who is honest, that he is dishonest. Consequently, when a strong aroma of corruption has gathered round an officer, very rarely will it be wrong specially and thoroughly to investigate his actions, his financial position, and the financial position of such of his relatives and close friends as seem to have acquired a somewhat large share of the good things of the world. No such officer should, in any case, be kept in any position of responsibility or influence.'

(c) Frustration at the lack of opportunity for the exercise of one's talent and at the lack of recognition of the initiative and originality shown by some engineers is one of the principal causes of demoralization.

(d) Legitimate expenditure by engineers should be examined with due regard to (i) the necessity of keeping two establishments — one of which is for school-going children, (ii) expenditure on sickness or on education of children, and (iii) minimum hospitality and entertainment to visitors, etc. Cuts in salaries and allowances act as an incentive to malpractice, when one's legitimate expenditure cannot be met. Urge for additional income therefore through malpractice, share market, capital gains by property transactions, business in the name of a relative, etc. become irresistible. It will be worth while for our Institution to conduct a a statistical survey of the income and expenditure of all grades of engineers with a view to finding if the emoluments are commensurate with their minimum requirements.

(e) Maintenance of high ideals and traditions of public service through associations and institutes by framing rules of conduct and duties.

(f) Property and patronage will lose their value if we really have a socialist pattern of society, with equality of opportunity and social justice. If the desert is turned into a garden one need not rest long at the oasis.

4.3. Dignity of work

Equality of opportunity need not be understood in a restricted sense. Every man has not only a right to employment and reward for his work, but he has also a right to some intelligent work which will excite his intellectual and mental capacities. Using a man as a mere machine for mechanical handling of a given assignment for long hours does not leave much scope for elevation of his personality and is likely to result in his degradation. Intelligent work is as essential to men as air, water, food, shelter and clothing. Work is not merely a means of livelihood. It has a distinct purpose in building up the personality of man. Absence of such work is at the root of all vulgarity, corruption and strife and everything that degrades man. Although using a man as a mere machine is inevitable in some of the large scale industries, it is possible to apply a corrective by diversions to sport, arts, music and other hobbies during the leisure hours. Man gets reasonable opportunities for creative work in agriculture and in cottage industries. Cottage industries should therefore be looked upon not with the yardstick of classical economics, but should be considered as a healthy means of production and education which incidentally saves the State the headaches arising from the unwieldy growth of cities. The field of cottage industries should not be restricted to mere hand spinning and hand pounding. Small machines may be used and products like scientific instruments, watches, glassware, etc. should come under the purview of cottage industries. Expansion of such industries can be encouraged by the establishment of guardian Government organizations for procuring permits, providing raw material on credit, and purchasing, goods at guaranteed prices — all at the door of the industry.

The principle of giving man sufficient scope to his initiative must also be practised in the engineering departments. Too much centralization of design must be avoided. Sufficient initiative and responsibility should be left at the level of the Superintending Engineers, Executive Engineers and Deputy Engineers.

The spectacle of ordinary abutments, culverts and bridges being designed at Delhi and the Superintending Engineers and their lower officers being reduced to positions of supervisors and audit clerks is not very encouraging. These officers cannot in these circumstances take real technical interest in their work. Such a policy results in the rusting of whatever technical knowledge they possess.

The problem of full employment should be considered with this human aspect. Providing some kind of alternative employment for a person to which he is not suited degrades the mind of such an individual. Intelligent and interesting work is man's first right whether it carries with it sufficient emolument or not.

4.4. Rational, scientific and self-reliant attitude.

Engineering science and our profession cannot grow in stature if we depend too much upon others and their experience and follow the trodden path by thumb-rule methods. Politicians are showing greater courage in trying new ideas of social order at considerable risk. India has built such amazing international prestige entirely due to the idealism and self-reliance of its political leaders. Why should we not show greater courage in approaching our problems?

We should have faith in our theories and in our experimental results and should give up arbitrary methods. Structures are getting costlier due to our conservatism without any corresponding benefit in strength and utility. We should be a little more research-minded. No statistics for river valleys, for flood discharges, roughness coefficients of canals, and so on are being collected. Strength and utility do not increase with the amount of money spent. There is considerable scope for improvement in our designs of houses, bridges, aqueducts and mechanical equipment. Rubble masonry has been extensively used in dams and buildings but we do not have a rational uniform code for masonry structures giving safe permissible stresses in rubble masonry. We have been using lime mortar for generations and many of us do not know the significance of the composition of hydraulic lime. Design of concrete and masonry structures subjected to combined flexure and compression has still not advanced beyond the middle third. Houses worth crores of rupees have been constructed during recent years. But there is no original investigation on the output of an artificer and the method of improving it, or on the method of planning steel, timber and other material for a whole project on a scientific basis. It is still not appreciated that almost twenty percent saving can be effected by organizational efficiency without reducing the standard of houses. We are too critical of indigenous equipment and machinery. It is only by frequent use that we can improve the quality of our products. Many of us are still afraid of welding. New original designs must be tried at some risk and cost. With the opportunity to construct so many dams, we are still disinclined to use anything but concrete gravity dams. I do not want to suggest that we are absolutely static. Our irrigation engineers have certainly the pride of place of having made great progress in the science of irrigation. Our hydro-dynamic research stations are doing splendid work. But the totality of the progress of engineering science in India is not increasing at compound interest.

Universities can make a substantial contribution if students are encouraged to take the master's degree in engineering with thesis. Engineering departments can spend more funds on investigations, analysis of existing structures, river gauging, etc. Needless to say that the scope for original approach in mechanical and electrical engineering is greater than that in civil engineering.

Progress lies in taking a dynamic attitude and not in adhering to the old. Similarly in view of the fact that State enterprise on a very large scale is being introduced we must bring in efficient methods of management in our offices, on construction works, and in production. There should be independent statistical checks on our performance and we must have an open mind to accept the results and carry out improvements. A qualified engineer with experience of many years should be able to understand the principles of management without attending a course or taking an examination. Management is an applied science and it only grows by use and experience. Although courses in management should be introduced, that alone will not solve the problem. Application of management methods on a large scale and training of the whole staff from day to day is necessary.

5. Coordination of the private and the public sector

5.1. Integration of the private and public sectors

It is gratifying to note that the authorities are willing to look at the public and private sectors combining to form a national sector. Cooperation and goodwill and not belligerency are needed between the two sectors. The private sector need not be considered as a fattened calf to be feasted upon on an appropriate occasion. The private sector should not have the feeling that it is to be'nationalized gradually at the will and pleasure of Government. The private sector should be relieved in their mind of any possible large scale socialization of all industry. If the harmonious blend between the private sector and the public sector can be brought about without detriment to the final objective of equality of opportunity and social justice there is every chance of the authorities being inclined to accept Gesell's anti-Marxian socialism with necessary modifications as their ideal social order. It is of course clear that a sort of strategic control that the State will exercise on the private sector will not be to the liking of the present-day leaders of the sector; but if they consider the whole economy of India and the socialist objectives they will have to see eye to eyewith Government in the new role in which the private sector is expected to appear.

In the strategic control that Government will exercise on the private sector, the Government executive will have to cooperate with this sector at the institutional level so that a lot of difficulties and misunderstanding will be avoided. In this connection an important difficulty experienced by the small producer in making so many returns to Government needs careful attention. There must be some relation between the total produce of a producer and the expenditure he has to incur on non-productive clerical work in making returns to Government and in I obtaining permits. State executive and State enterprise can learn a good deal from the experience of the private sector as there is a lot of accumulated experience and know-how with this sector which can be useful to the efficient running of State enterprise. In fact it is necessary that there should be a free exchange of personnel between the private and the public sectors to mutual benefit. The employees of both the sectors are all engaged in nation building activities and it is but fair that both should get equal treatment. The present-day method of giving special facilities to State executives by way of requisitioning of houses creates a class consciousness amongst them which is detrimental to their efficient functioning.

5.2. Pilot scheme of State enterprise

In order that State enterprise should run efficiently, it will be worth while trying to have some pilot organization sponsored by Government for running on a small scale some State enterprise in competition with private enterprise. There should be, for instance, one or two construction companies sponsored by Government. These construction companies should tender for works in competition with other contractors. Similarly, a pilot organization in the production of goods or even in some of the corn-merciallines may be established by Government to compete with the private sector. Such organization will be a training ground for the State executive in the efficient running of State enterprise.

5.3. Using the talent available among practising engineers

Deliberate attempts should be made to make use of the talent available amongst the practising engineers. The work should be distributed to private engineers on .merit and without favouritism. Even if such association of private engineers does not bring any immediate benefit to Government, I would suggest that it should be given a trial. Unless private engineers are associated with the Government schemes on a larger scale than at present, there is no hope of establishing firms of consulting engineers in the country. Firms of consulting engineers work not merely on ideas. Accumulated data and experience is the essential foundation of all consultation. It is necessary that the State should encourage firms of consulting engineers by giving them some guaranteed work and subsidy, even if such consultation is not found very economical to begin with. Similarly, any consultation with outside experts should with advantage be taken through indigenous firms of consulting engineers. One great indirect advantage of immediately encouraging establishment of consulting engineers' firms in the country will be the expected exodus of many efficient and old engineers from Government service to private practice. That will be a very welcome situation. The knowledge and experience of these engineers will be available to all and not to any particular State or organization. Many of the old engineers are at present blocking the way of young engineers to go to the top. With due respects to their capacity and knowledge, the history of engineering records that it is only the young engineers who can carry out works with vision, originality and courage. Old engineers will be useful for giving advice when it is sought: but it should not be obligatory to implement such advice. The final decision should rest with the younger generation.

6. State executive

6.1 : Secretaries of technical departments

In the process of establishing a socialist State an increasingly large field of economic and industrial activity will be managed and controlled by the State, and in many cases engineers will be directly responsible for such management and control. Irrigation, roads and railways, small scale and large scale engineering industries, production and distribution of engineering materials, production and distribution of power, are some of the instances of State activity which will require a high degree of technical knowledge and experience. The steering, braking and accelerating of all these activities have to be done at the level of Parliament and Treasury. The link between the engineering departments on the one hand and Treasury or Parliament on the other is through a Secretary belonging to the Administrative Service. He is by design an experienced administrator not possessing specialized technical knowledge about the facts and figures, issues and processes of any particular departments. This has caused a lot of irritation and discontent amongst the heads of technical departments. A dispassionate consideration of the pros and cons of the issues involved in the controversy is necessary. The grievances of the engineers and scientists are briefly as under:

> 'The duties of the administrative cadre are concerned with the formation of policy, with the coordination and improvement of Government machinery, and with the general administration and control of the department of public service. This cadre comprises immediate advisers and the entourage of the Minister. Over the last half-century the duties of Government have become increasingly technical and scientific. Yet, the supreme control of even technical departments and the general channel of advice to the Minister is still vested in the administrative Secretary who is usually recruited for ability in the classics, history or

mathematics and indeed in any group of subjects other than the technical details of the department he is supposed to control.

The limited police and supervisory functions of the State a hundred years back might be adequately served by literati and Brahmins but the modem State needs engineers, scientists and businessmen. Engineers have found that a mere consultative role and the right of access to the Minister do not lead to satisfactory results. They should be permitted to advise on the shaping of policy. Unless the engineer is faced with the whole problem his technical advice is likely to be unrealistic and sometimes incorrect. There is always the danger of technical advice given under one set of circumstances being reapplied to entirely different set of circumstances with disastrous results.'*

**S. E. Finner. 'A Primer of Public Administration', p, 117-118.*

These weighty arguments in favour of the appointment of scientists and engineers as Secretaries of departments have not made any impression on the authorities. It is argued that the authorities are at present under the influence of the I.C.S. and the I.A.S., and the Administrative Service are naturally not willing to give up their right to certain posts which have been acquired by them during so many years past. The denial of the post of Secretary to engineers and scientists cannot be attributed merely to the greed or avarice of the Administrative Service. There must be some deep-rooted reasons behind the insistence of the Administrative Service that engineers are unsuited for the responsibilities of these posts. These reasons can be traced to the history and development of the Civil Service during the last 100 years.

It was in the year 1834 that Macaulay laid down the principles of recruitment and promotion of the Indian Civil Service, and the traditions of the Civil Service have been created and jealously maintained since that time. There was a committee on selection and training of candidates for the Indian Civil Service with Macaulay as one of its members. Macaulay and the members of his committee were antagonistic to any technical preparation for the examination of such a post for they had their eye upon the classical and mathematical education at Oxford and Cambridge of their day. They searched for general ability, intelligence and not merely special acquirements, for according to them there was no limit to the demands which might ultimately be made on the abilities of this class. They believed that technical preparation might be simple cramming and thus those most able at cramming would beat people of superior mind. Macaulay believed that it was not the subjects learnt which assured of administrative ability but the proficiency therein even if it was as remote and backward as the Cherokee language. His argument in his own words was as under :

‘Men who have been engaged up to one and two and twenty in studies which have no immediate connection with the business of any profession and the effect of which is merely to open, invigorate and enrich the mind will generally be found in the business of every profession superior to men who have at the age of 18 or 19 devoted themselves to the special studies of their calling. Indeed, early superiority in literature and science generally indicates existence of some qualities which are securities against vice-industry, self-denial, taste for pleasures not sensual. a laudable desire for honourable distinction, and a still more laudable desire to obtain approbation of friends and relatives. We, therefore, think that the intellectual test about to be established will be found in practice to be also the best moral test that can be devised’.

Hence it was presumed that perseverance and self-discipline which are hardly less important than intellect in the practice of administration were tested in some measure by the literary competition based on university studies. It will be interesting to note that in those times there was no administrative machinery in India worth the name. So Macaulay had almost a clean slate on which to model his structure of an ideal administrative service. In England itself there was some sort of an administrative service coming from the aristocracy and it was not easy to introduce these principles in the British Civil Service. It was after the submission of the report by Macaulay and his committee regarding the principles of recruitment and promotion in the Indian Civil Service that the British authorities made use of this report in framing the rules of recruitment and promotion in the British Civil Service also. Looking to the history of the Civil Service in the United Kingdom and in India it must be admitted that the claims of Macaulay regarding the quality of the Civil Service have been more or less fulfilled. Civil Service personnel have occupied various positions which had no bearing to the actual education taken by the persons concerned in their universities. The most patent instance is that of some Civil Service men entering the Judiciary and occupying with distinction the position of High Court Judges. That administration is a science which requires intelligence, foresight and vision which come very easily to man by university training in the humanities, literature, history, etc. cannot be denied. During the last hundred years the traditions of the Civil Service have been still further developed in relation to parliamentary democracy and the duties of the Civil Service have been defined by convention which cannot be easily broken. It is worth our while to study these developments in order to be able to understand the exact implications of an administrative post. The duties of a Secretary of the department can be briefly described and explained as under:

The doctrine of cabinet government in democracy rejects the theory that the Ministers should be experienced in the techniques of the affairs of their departments. The Minister is not a man of science. His function is that of persuasive advocacy in the Parliament. The Secretary is his principal adviser. The Secretary is like a non-partisan Minister — he is the Minister's other self — giving impartial advice in private but loyally carrying out the commands of the Minister whether he agrees with them or not. The presentation to the Minister of all relevant facts and inferences demand from him all the wisdom and detachment he can command. The Secretary not only carries out the commands of his Minister but also decides some issues himself to the extent of the power delegated to him and in doing so he is bound to decide the issues as his Minister would have decided them. He has to resist the temptation of being too original and constructive in imposing his views on the Minister. The Minister is answerable to Parliament in his task of executing public will. The Minister is more concerned in satisfying Parliament than in providing technically the best solution. In doing so, he needs the advice of a non-technical Secretary. The Secretary has not only to tell the Minister what the department is working on and what problems are likely to arise but he has also to advise the Minister what policy is palatable to other ministries, what parliamentary interests are likely to pass it, and what the opposite political strategy has to debate. The Secretary has to temper his appreciation of technical beauty with a keen sense of public relations. In order to be able to carry out the delicate task the Secretary has to bring to bear upon his work his fund of long experience in various other departments. He has the necessary training in the humanities; the qualities of giving anonymous and impartial advice, of obedience, of high integrity and character, of ability to marshall facts and draw inferences, are not acquired in a day.

These qualities are cultivated over a long period of service in the best traditions of the Civil Service. It is further argued that the engineer is not, therefore, suited to become Secretary of the department. His education is too technical and one-sided, lacking in the humanities. He has no experience of other departments. The nature of his work in the actual day-to-day execution of duty is such that he has many items to compromise with principles. He is thus incapable of assuming that detachment and independence of mind, impartiality of judgment, and readiness to obey which are so essential in the Secretary of the department. Moreover, due to shortage of technical personnel it is not in the interests of the country to allow capable, intelligent and young engineers to compete for the Administrative Service.

We have before us now the full case in favour of the I.C.S. and the I.A.S. regarding their claim to occupy the key position of Secretaries to the technical departments. It will be seen that the whole theory of the Administrative Service is based upon conditions which existed a hundred years ago. In those days the State was more concerned in maintaining law and order. The State has now undertaken the functions of a welfare State which include the management of industries and other enterprises. Moreover, the old theory of Oxford and Cambridge that literature and mathematics alone had the power of training the mind is now given up even by the Oxford and Cambridge Universities. Mechanical sciences have also got the pride of place along with literature and mathematics in these Universities. So, in the year 1955, it is idle to argue that training in mechanical sciences does not open, invigorate and enrich the mind.

Secondly, the traditions of the British Civil Service in its relation to parliamentary democracy do not apply to the Indian Civil Service. The Indian Civil Service has been accustomed to more despotic methods of administration. These civil servants were in full control of Government. They had in them the combination of the work of the present Minister and the Secretary. Naturally the personnel of the Indian Civil Service were not brought up in the democratic atmosphere of the British Civil Service. It is difficult to imagine that the Indian Civil Service have given up their old habits, immediately after the introduction of parliamentary democracy in India. They are unconsciously carrying on their work in the old way and it can almost be said that they exercise more discretion and power than is visualized in the Secretaries of the departments of the British Civil Service. Moreover, the I.C.S. and the I.A.S. are not only occupying posts of advisers to Ministers and normal Secretaries' posts but they are also occupying other key executive posts which cannot by any stretch of imagination be called mere advisory posts. Some of the executive posts such as those in charge of municipalities, ports, river valley projects, industries, etc. certainly require good deal of technical knowledge of the departments. A careful examination of the working of the departments with the administrative personnel as heads of the departments will show that there is a lot of red tape and loss of efficiency in output due to the fact that the heads of the departments have not got the necessary technical knowledge of the departments they govern.

The argument that engineers should not be permitted to compete for recruitment to the Administrative Service because there is a paucity of engineers is very interesting. According to this argument all the I.C.S. and the I.A.S. men will have to be sent to fill the vital posts of teachers and professors on account of the paucity of qualified teachers in the education departments.

Fact of the matter is this. Balanced development of the mind requires training in the classics, mathematics and some art or craft. The I.C.S. and the I.A.S. suffer from a kind of one-sided training with too much emphasis on words (written or spoken) rather than on action. This defect in their training is the cause of the failure of the administration to take a realistic view of the present day problems. They cannot see their defects because they are their own judges. But this state of affairs cannot last long. Whether engineers are appointed Secretaries or not is not very material. The main question is to have an administrative set-up which can deliver the goods and the conclusion is irresistible that the training and education of persons to be recruited to the administrative services should have a core of realistic technical knowledge to be able to do justice to their job. Otherwise papers pertaining to duty of canals will go the Home Department and those pertaining to welded fabric will go the Textile Department. The engineer with twenty-five years' experience has sufficient knowledge of other departments. During his long service he comes into intimate contact with labour, farmers and other people and is in a better position to advise the Minister in his relations to Parliament. An engineer's work is creative. He would not ordinarily like to accept a less inspiring job of a Secretary. But the interests of the expeditious and efficient working of the department require that the adviser to the Minister of an engineering department should be an engineer. It must be admitted that there have been in the I.C.S. and the I.A.S. men of exceptional ability who have shown good grasp and vision of the working of engineering departments. In fact, the history of many municipalities, ports and other executive organizations will show how their fortunes fluctuate with the type of

I.C.S. and I.A.S. men that are sent to govern them. A man with vision almost electrifies the atmosphere and carries out many improvements with speed and efficiency. A myopic administrator does the reverse and both types of administrators belong to the I.C.S. But an engineer who is selected for the post of an administrator has always been found to be man of great foresight and ability because of his realistic and sympathetic approach to human problems.

In a socialist pattern of society an administrative set-up of Government will have to be changed on the following lines.

(a) Chief Engineers can be made Secretaries of technical departments.

(b) Engineering graduates should be permitted to compete for the I.A.S.

(c) Some Executive Engineers showing special aptitude for administration can be taken into the regular I.A.S. to make up the deficiency of technical knowledge in the I.A.S.

(d) Promotions to higher administrative posts should be by selection. Such promotions should be restricted to those who have a reputation for character and integrity and who have shown some exceptional merit in extra service activity.

(e) A special cadre should be provided for managerial work.

6.2. Relations with contractors

An important aspect of public service which will have great potentiality for good or for evil in a socialist pattern of society is the vast field of discretion, rule making power, and power of decision in a quasi-judicial capacity that will be left in the hands of the executive. In fact the three pillars of a modem State are, (1) the legislative power of Parliament, (2) the executive power of secondary legislation, and (3) the Judiciary. Past experience of the use of power by the executive is not very encouraging. But it is hoped that with experience of parliamentary democracy in a socialist pattern of society some conventions and etiquette regarding the executive's relations with the public will be slowly built up. This is a vast subject to discuss. I will take only the relation between engineers and contractors by way of illustration.

The methods of dealing with contractors that are followed at present have not been helpful in advancing efficient and economic methods of construction. The contractors' profession tends to be a gambler's profession due to the way they are dealt with. Engineering defects and uncertainties are said to be solved by putting impossible and irrational conditions in the contract. Contractors are supposed to study the hydraulic characteristics of a river and the nature of the foundation strata, some 20 ft. below river bed level, within about three weeks—a task which the engineer could not do in perhaps three years. Rates for items of composite construction such as R.C.C. are given per cubic foot leaving the extent of steel and concrete to the discretion of the engineer. The conditions regarding contract documents — instead of improving—are rapidly deteriorating The principle of arbitration is still not accepted in its true spirit. Instead of encouraging a competent builder. who has organizing capacity and the construction know-how. a contractor with the backing of big finance is given preference. Earnest money deposits are returned several months after the opening of tenders. Conditions regarding deposits and their refund appear to be intended to scare away competent builders and to attract financiers or capitalists. Risks involved in fluctuation in the cost of labour and material are to be borne by the contractor. These methods surely are not in keeping with the modern trend of having a socialist pattern of society. These are methods of introducing gamblers and financiers in the construction line. Suggestions to introduce modern insurance methods to cover risks are repelled. All contract risks are insurable and engineers should be progressive enough to accept insurance bonds in lieu of earnest money and securities. In suggesting improvements in the administrative machinery, Mr. W. R. Natu in a recent lecture has made the following observations:

'The risks of development should be assumed by the strong instead of by the week. The group is stronger than the individual; the State is stronger than the group. The dice should not be loaded against an illiterate people on the margin of subsistence. The premium on the written word, the demand for sureties, the requirement for security, etc. should be done away with as far as possible. The process of obtaining refund should be as simple and as prompt in result as the demand for revenue. The risks of price fluctuations are better borne by the Government than by cooperatives or individuals. The principle of insurance should be extended to cover every type of risk in whatever field.'* Surely, drastic changes in the rules of the P.W.D. with regard to its relation with contractors and others are called for if the P.W.D. policy is not to run counter to the State policy of a socialistic pattern of society. Human value and not money values should be the backbone of executive regulations and rules.

** 'Public Administration and Economic Development', being a lecture before the Gokhale School of Politics and Economics, Poona, p. 15.16.*

7. The Institution

The Institution of Engineers has a vital role to play. The Institution is indeed the pulse of engineering life in India. It is the only meeting ground for engineers of all ranks and-all branches. Such Institutions are intended for the establishment and maintenance of healthy traditions of the profession and brotherhood of engineers. In our formal and informal gatherings, we have occasion to meet each other and to learn from each other's experiences. Such associations are known to help the maintenance of high standards of conduct and etiquette of the profession and the stray member who breaks the pace automatically corrects-himself. The Institution has recently prepared a comprehensive Code of Ethics. It shall be the duty and privilege of every member to observe this Code and help others observe it.

The Institution is not unmindful of its important function of the advancement of science and practice of engineering. It can do so by publication and discussion of papers, spreading of technical information on different branches of engineering, providing an information service, publishing reports on important problems that face us, etc. Most of the engineering works in India are being done in the public sector and the Institution naturally depends largely upon the active cooperation of its members in Government service in promoting its technical activities. The growth of engineering as a dynamic science in India depends entirely on our contribution. Publication of reports through the Institution and exchange of views and experiences on a platform like ours can be best appreciated from the following observations of a well-known economist:

'Writer of a book, heading along unfamiliar paths, is extremely dependent on criticism and conversation if he is to avoid an undue proportion of mistakes. It is astonishing what foolish things one can temporarily believe if one thinks too long alone.'* Government should take advantage of the Institution by entrusting the investigation and consideration of important problems through the Institution committees consisting of officials and non-officials. Government can grant funds to the Institution towards the expenditure of preparing such reports. Government Chief Engineers will surely appreciate the value of reports coming from a representative body like the Institution. There is no doubt that such ventilation of a problem in the open air of the Institution would bring good results. Government engineers in high position should consider it a privilege to sit by the side of their junior members in committee meetings of the Institution for deliberation of technical matters. In a democratic State such a habit of meeting on an equal level of engineers of all standings will create a feeling of brotherhood between them and will consequently have the effect of increasing the efficiency of the work. Institution members can read papers and discuss them on the Institution platform.

**'J, M. Keynes in his preface to 'The General Theory of Employment, Interest and Money'.*

There is a feeling amongst some members that they do not get sufficient return for their money. The working of such an all-India body requires funds which are .partly constant and which partly vary with the number of members. If we compare our expenditure on different heads, namely, the Headquarters, Local Centres, Journal, etc., we will find that our ministerial expenses are low when compared with corresponding expenditure in other Institutions. Our services can increase if our income increases either through larger membership or through grants from Government. The membership of some of the foreign Institutions is of the order of many tens of thousands excluding students. Government might appreciate the importance of an Institution like ours in the advancement of engineering science and give substantial capital and recurring grants for the furtherance of these technical activities. Such grants will be of much advantage to Government in the shape of increased economy and improvement in design in all Government undertakings. This is not a mere academic proposition; all of us know the value we derive from papers and discussions published in the Journal of our Institution and in the journals of British, American and other foreign Institutions. All of us are also aware of the value of the technical papers published by the Punjab Engineering Congress, the Bombay Engineering Congress, and similar associations in other parts of India before their amalgamation with the Institution of Engineers.

The Council of the Institution is fully aware of its responsibility of giving technical service to its members. The Council is keen to have buildings and libraries in different parts of the country. Everything possible within the limits of our funds will be done. Another important activity of the Institution is the Studentship front. The importance of Studentship of the Institution and of the Institution examinations cannot be too highly stressed in a country like India with socialist ideals. Our ideal is to give education on a mass scale. Not all of the workers can afford the luxury of university education. There must be some means of testing the competence and ability of these workers who show exceptional merit in their performance. Any worker who carries on his studies and acquires experience under the guidance of an engineer and passes the practical test of the Institution can stand on the same level as the university graduate. Such test has great significance in a democracy like India with socialist aims. The Student members of the Institution are not merely drawn from the ranks of workers. University engineering graduates can join us immediately after passing and entering an engineering career. We thus provide a very wide platform for our young engineers from the very beginning of their career with a view to impressing upon them the traditions and the standards of the profession. This is not all. Bombay and Bengal Centres have initiated Student Chapters or Student Sections with a view to encouraging technical discussion amongst the Students themselves. This provides an opportunity for them to write dissertations on technical subjects with the prospect of some of them being published in the Institution Journal. They also get valuable opportunity of speaking in the meetings of engineers and students. This training ground has great potentialities in the building of our young generation of engineers. All our Corporate Members will give full cooperation in the working of these Student Chapters or Student Sections. Similar Student Chapters will, no doubt, be opened in other parts of India. Another technical service that has been started by some of the Centres is the meeting of study groups in different branches of engineering. Engineers and others interested in a particular branch of engineering may teach each other and discuss their problems and exchange views and experiences. The study group meetings are very useful not only to junior engineers but also to senior engineers. There is no reflection on the senior engineers in saying that they are in need of refreshing their basic knowledge of engineering. Study group meetings will be started at many places in India and engineers of all ranks will take active interest in such meetings. This is our Institution and the Institution will get the shape that we give it. Let us all make up our mind to help ourselves to raise the status and usefulness of this Institution higher and higher every year. Our aim has always been 'Excelsior'.

Prof M S Thacker

President 1955-56

Presidential Address

I am deeply conscious of the honour you have done me in electing me President of the Institution of Engineers (India) for this year. For a professional body, such as this Institution, comprising practical men with a progressive outlook, great opportunities have opened out under the expanding economy of the country and it behoves us all to rise to the occasion and dedicate ourselves with zest to the service of the nation. As our Prime Minister has often said, 'It is an exhilarating experience to be living in India today when destiny provides the opportunity to change the face of the country.'

I am told the B.B.C. advises intending speakers to ask themselves four questions: 'To whom am I talking? What am I saying? Why I am saying it? Is it worth saying?' In the present case, the answer to the first question is obvious. Regarding j others, it is my intention to talk to you about the vital role which engineers have to play at the present juncture of our national development; and I have no doubt at all that on this occasion I am speaking on the right subject, to the right persons, and at the right time.

The engineer belongs to a constructive profession and he has the reputation of exerting himself to 'deliver the goods' on which the progress of material civilization depends. If he has to live up to his reputation, he has to occupy himself restlessly in a restless world, ever designing, producing, and 'delivering the goods' expected of him.

Our progress in engineering research, save in irrigation engineering, has not been impressive. The number of engineers taking to research is small and the facilities for research need to be considerably strengthened. By and large, our engineers are engaged in routine maintenance and constructional operations or in testing and standardization work. Important as such work undoubtedly is, routine tasks, such as selecting, ordering, following up, inspecting and maintaining plant and machinery, do not lead to spectacular and worthwhile developments. Our research effort does not measure up to our needs. Engineering is a vast and very live field and new technologies calling for specialization and expertness keep cropping up. It is also a field in which quality is all-important: two second rate engineers are not a substitute for one first rate man. We have to build up our organizations for engineering research and encourage adventure in new and unbeaten paths to develop the abilities, competence and skills of the youth of the country. It is only then that we can face the many constructive problems before us boldly and confidently, and with the assurance of success.

Search for new sources of power

Gentlemen, as you know my field is engineering science dealing with power. There has been a staggering rise in the consumption of energy all over the world in recent years. A rough calculation indicates that power. consumption in 1954 was approximately ten times the average annual consumption during the period 1850-1950. Energy consumption in India has been low and the need for increased power production has always existed. The rising tempo of industrialization has added urgency to this need. Under the present pattern of energy production in India (1953), coal contributes 19%; oil, 3%; hydro power, about 1%; wood, 3%; and agricultural and farm wastes, the balance. The use of farm wastes as a source of energy must necessarily diminish; its appropriate use is in agricultural practice. The present pattern of energy production will have to change and new sources must be exploited and harnessed. The Natural Resources Division of the Planning Commission has estimated that the installed generating capacity for electricity would have to be raised by 1986 to sixteen times the present capacity to meet the anticipated requirements of successive Five Year Plans. Leaving aside the contribution of hydro power (for which our potential, estimated at 35 to 40 million kW per annum, may be considered perennial) the demand on coal for thermal power generation would continuously increase; coal is also an essential raw material for other important industries. Assuming a doubling of production every ten years during the next three decades, coal production will have to reach 360 million tons per annum by 1986. The practicability of raising so much coal is a matter for serious consideration. Further, such large scale drain and prodigal use of natural resources cannot be sustained over many years. It is apparent, even from short range considerations, that reliance on fossil fuel sources is no longer possible. Attention will have to be directed to nuclear and other sources of power for meeting the energy requirements of the country and the harnessing of these resources is predominantly a problem for engineers.

India possesses the largest thorium deposits in the world. The beach sands of Travancore and of certain areas on the east coast are estimated to contain 150,000 to 180,000 tons of thorium in a readily extractable form. Known deposits of uranium ore containing more than 0.1% of uranium are estimated to contain a total of at least 15,000 tons of uranium; very large quantities of ores with somewhat lower uranium content are available. The known resources alone work out to the equivalent of 600,000 million tons of coal, or roughly 15 times the estimated total reserves of coal in India.

The Department of Atomic Energy of the Government of India has formulated plans for building atomic power plants which will breed fissible materials (plutonium and uranium-233) equal in quantity to the fertile materials (thorium and uranium) burnt. For this purpose, enriched nuclear fuel is required. This can be obtained from natural uranium in a gaseous diffusion plant or from power reactors designed to operate on natural uranium. It is proposed to set up in the initial stages atomic power stations which operate on natural uranium and effect the maximum conversion of fertile to fissible material for subsequent use in breeder power stations, thus enabling the reserves of uranium and thorium to be utilized for power generation.

This development presents many engineering problems, e.g., structural materials, effects of radiation on metals, shielding and protection of personnel, heat transfer, temperature control, and others, requiring the evolution of new techniques and the application of established principles to different conditions of energy release.

A source of power, which is abundant to the extent of being inexhaustible, awaiting development is solar energy. The mean energy incident per hour per sq. ft. of the earth's surface, under tropical conditions, is estimated to be 3,000 B.Th.H (0.25 lb. coal equivalent), but the low temperature at which it is available makes its conversion into mechanical energy inefficient. Power production from solar energy has received much attention in recent years. Experimental solar boilers for low pressure steam have been operated with the help of suitable collectors, but the total efficiency so far reached is of the order of only 8%. The direct use of solar energy in a heat pump holds attractive possibilities.

Studies recently made of the temperature difference between the surface water and the water at 5,000 ft. depth in tropical seas indicate a difference of as much as 30°F. Such high thermal differences between 'limitless' masses of water suggest the possibility of obtaining great quantities of energy for industrial purposes. It is learnt that the French Government has carried out trials off the Gold Coast of West Africa and the economics of utilizing thermal sea energy are considered favourable. A centre for oceanographic research has been functioning under the Council of Scientific and Industrial Research and I hope that this problem will receive due attention.

The exploitation and utilization of new and unconventional sources of energy presents many complex problems. Their solution requires considerable engineering research and a large corps of skilled engineers.

Research development and industry

Another field which has to be developed immediately and where engineers have also to play an important part is industrial engineering. This has application to industrial expansion which is one of the most important problems facing the nation today. Expansion is desired in industry as a whole and industrial manufactures should be established in fields which have not hitherto received attention. Such expansion is essential if we are to carry through the extension of our I social services. It is clear that without the aid of science and technology no real and sustained expansion of industry is possible.

The important part which scientific research can play in the development of Indian industry in the immediate future and in the years to come has not been fully appreciated. For upon the response which industrialists make to the tremendous opportunities afforded to them by science depends our industrial future.

Our scientists and engineers. I am convinced, are as good as any in the world. Given the opportunities, and such opportunities are being increasingly provided, our scientists can produce results and our industrialists can be persuaded to accept proved results. There is, however, one essential link in the chain connecting research with industry, which lies in the domain of engineering and to which we have not given adequate attention.

The link which is commonly referred to as 'development' is the proving of research results to the stage of acceptance by industry. Experience has shown that results available for application in industry are not lacking from any active research laboratory. What is lacking is the 'development' of these results to the stage of acceptance and adoption by industry. The induction of more engineers with necessary skills and with a research outlook into scientific institutions and more attention to planning of research programmes would help in shifting the emphasis to development work. According to a survey carried out in the U.K. a few years ago about one-third of the university graduates engaged in applied research are engineers, the rest being mathematicians, physicists, chemists, metallurgists, biologists, etc. We have no figures to show the proportion of engineers engaged in research in India, but the proportion is certainly not so high, except in institutes specializing in engineering subjects, e.g., irrigation research, building research, or road research.

As Director of Scientific and Industrial Research, I am deeply interested in the technology of development which transforms the formulae and diagrams of scientists to machines and equipment. We have too long concerned ourselves with science and its endless frontier, It is time we stripped science of its romanticism, put it to work, and produced results. We should take up the immediate development, in India, of this specialized branch of engineering which puts science into action so that we may reap the benefits thereof even in the present generation.

The emergence of this specialized branch of engineering with its tremendous implications for industry is a recent phenomenon. Research development proceeds in three more or less clearly distinguishable stages, namely, technical or engineering research, design and development. The first relates to the application of new knowledge or previously existing knowledge to a new process or product. It cannot be classed as fundamental research; at the same time, it must not be confused with mere improvements or alterations in existing products and processes, It is undertaken with the idea of securing basic data in textual, tabular or graphical form, data which are necessary for the next step, namely, prototype or process design. This stage is concerned with drawings, tolerances, and materials of construction. If the article is intended for mass production, the requirements of production engineering will have to be borne in mind. The final stage is development of the prototype or the process leading to actual production. It is again an engineering process and consists in subjecting the design to proof procedures, the discovery of omissons and deficiencies, and their correction. Like research, it calls for unusual powers of perception on the part of the individual.

Research and development are neither a kind of Siamese Twins, as one might judge from the popular opinion, nor steps in a sequence. They can exist separately and in India they have remained separate too long. They are merely two important and complementary steps and both of these require to be handled by specialists and persons of ingenuity. Development lies within the domain of the engineer and without it applied research becomes sterile. While basic work in clearly designated fields is necessary for the valuable stimulus it provides for technical research, actual application of such research for the evolution of a new process or a product requires for the greater part the techniques of design and development.

The application of engineering to research development involves economic considerations often neglected in the deliberations of our scientist colleagues. Here costs must be balanced against returns and the balancing is not merely in terms of money, but also in terms of manpower. Research applied to production must tackle four groups of problems, namely, industrial economics, production engineering, industrial psychology, and production management.

The design engineer and industrial consultancy

The reconciling together of the possibilities thrown up by research, the potentialities of production, and the requirements of the user is the job of the design engineer. If it is entrusted to the man who is primarily production minded, the result will be that he will follow well known techniques and resist any change which will modify the existing methods and equipment.

Designing work is undertaken in Western countries by corporations which have skilled engineering personnel on their staff. Such corporations also undertake other responsibilities. For instance, complete equipment required for an industry is rarely produced by any single firm anywhere in the world. Specialists in the fabrication of various units exist, and it is the function of the consulting engineer to analyze the needs of the industry, to draw up designs and specifications for component units, undertake their assembly and erection, and run the plant to ensure its proper working and scheduled performance.

Designs developed for one industry may find important applications in other industries also. Thus the designs developed for aircraft construction have been found useful for automobiles. It is only by organizing teams of design engineers that crossflow of references between specialized design achievements can be maintained for the benefit of industry as a whole. I am fully convinced that research in engineering design and materials of construction cannot be promoted unless we organize professional groups of expert engineers.

The building up of a body of design engineers is a primary requirement in the context of our vast development programmes on hand. At the present time, there are too few men of the type required to undertake or appreciate the value of scientific designing. We have made little effort to plan the training of design engineers. Far too many firms with a forward outlook are content to import their designs from foreign countries. This is a matter for great concern. While we should be prepared to learn from others whatever there is to learn, we cannot, and should not, perpetuate this dependence. We must build up a vigorous profession of design engineers in this country, and this is a matter demanding the urgent attention of scientific institutions, industry and Government alike. If the output of our research institutions is to be utilized for industrial advancement, it is incumbent on us to select and train our engineers so that they may have the required scientific background and practical experience to undertake designing and development work.

Research utilization has reached the highest level of efficiency in the United States of America and special attention is given to the training of personnel required for translating the results of research into industrial operations. Several American universities provide courses in industrial engineering, and industry and universities act in cooperation for ensuring that the training imparted is adequate. British technical colleges have also recently introduced training in industrial engineering and cognate subjects. A beginning has also been made in India. The All-India Council for Technical Education, the Scientific Manpower Committee, and the University Commission Report have all emphasized the need for expanding engineering and technical education and for providing facilities for post-graduate study and research in selected fields of technology.

Operational research

I have been talking about the role of engineers in the translation of research results into new processes and products. Recent developments have shown that operational efficiency and industrial production can be greatly improved even with existing plants, equipment, men and materials. I shall briefly refer here to operational research developed during the last war, and applied with great benefit to industrial operations.

Operational research is an orderly attack on problems of production calling for common sense, scientific discipline, and a certain amount of statistical knowledge. Quantitative assessment of the present performance and analysis of data reveal possible lacunae in organization and effort, and suggest measures for improvement. Operational research has been successfully employed in transport, coal, electricity and other industries, and the scope for its application is continuously expanding. One of the earliest applications of this technique to industrial productivity was in the manufacture of shoes. 'Shoeing the population' was considered as an 'operation' and a detailed survey of the feet of the population was carried out. Statistical analysis of the data resulted in a simple correlation between basic and secondary measurements of the feet and a new gradation in sizes was introduced. In the place of 124 different variations in size according to the old system, only 30 variations were found necessary. This finding led to great improvements in the productivity, economy and efficiency in the shoe industry.

Another instance of successful application of operational research was in the construction of roads. Surface dressing involves two operations, namely, tar or bitumen spraying and spreading of chippings. Tar spraying is carried out by a machine operated by only a few workers, whereas spreading of chippings requires a large number of workmen. The length of life of the dressing depends on the correct amount of tar spread uniformly; the rate of spread of chippings does not have much effect on the quality of the finished surface. Each operation was carefully analyzed and tests were devised and tolerances determined to effect a compromise between what was possible with the existing practice and the minimum requirements for long life dressing. The investigation proved to be of great value and substantial improvements in road construction operations have been claimed.

Operational research has helped in providing executives, whether in industry, or government, or anywhere else, with a better understanding of the working of their organizations and in predicting, with reasonable certainty, the effects of any changes which may be introduced into them. It helps in evaluating the actual productivity and the best production possible within the inherent restrictions operating in the unit, thereby enabling rational decisions to be taken.

Tasks and responsibilities

I have referred above only to a few of the tasks confronting engineers in India. There are others, for example, quality control and market research which are guided by statistical science and provide intelligence reports for research workers, design engineers, and production managers, to which I have made no reference for want of time.

We are living in a period of dynamic changes in the country. Old ideas of government and administration are disappearing fast. Government is no longer a mere organization for keeping law and order, and for collecting taxes and spending them on certain essential services. The affairs of the Government are becoming more and more deeply interwoven with the social, economic and cultural life of the people. The importance of the role of technical men in national development is being gradually realized. Addressing the National Development Council recently, our Prime Minister, Shri Jawaharlal Nehru, observed: 'I think that scientific and technical personnel should be introduced not only in technical processes but in administration also. The administrator is an able man and does a good deal, but his thinking is on different lines than that of the technical man. I think there should be greater inclusion of that type of thinking even in our administration and it is better to mix the pure administrator with the technical man and the scientific man. After all, the problems today are problems of science and technology. An able administrator or an able politician, just like an able lawyer, can grasp the main problem to argue this way or that, but it is one thing to argue from the broad outline and another to have grown up with that idea in the process. I think, therefore, that scientists and technicians should be associated more and more with various processes including administration and planning.' Gentlemen, the positive role which scientists and technologists ought to play in our national development has been indicated from the highest level of constructive thought.

Our Institution, which I can safely claim represents the cream of Indian engineering talent, has an important part to play in the development of the country. We, the members of the Institution, should realize this and be prepared to assume the responsibilities which devolve on us in guiding the developmental policies of the nation. This Institution has a valuable record of service to the nation and its continuing to function under its present Charter appears incongruous. It shall be my endeavour, as President, to assist the Institution to grow in strength a,nd to obtain for it due recognition.

Prof M S Thacker—a Brief Profile

Prof. M. S. Thacker (M.), Director of the Indian Institute of Science, Bangalore, has been appointed Director of the Council of Scientific and Industrial Research, Government ot India, in succession to the late Sir S. S. Bhatnagar. He will take up his duties in New Delhi this month.

Prof. Thacker is of course the Chairman of the Electrical Section of the Institution. The Section has vastly expanded under his vivid leadership, and for the first time in the Institution's history, there is no lack of good quality papers in this Section.

Prof. Thacker was Chairman of the Mysore Centre and Vice-President of the Institution for 1951~52 and 1952~53. It will also be remembered that he represented the Institution, with Maj.-Gen. H. Williams, at the Third Conference of Engineering [nstitutions of the Commonwealth in London in June 1954, and the Indian National Committee at the Sectional Meeting of the World Power Conference in Rio de Janeiro, Brazil, in July~ August 1954. He is also the Chairman of the Papers Committee for the selection of papers from India for the Fifth World Power Conference to be held in Vienna, Austria, in July 1956.

Rai Bahadur Kanwar Sain

President 1956-57

Presidential Address

‘I am immensely moved by the great honour conferred on me by the Council of the Institution of Engineers (India) in electing me President for the ensuing year. I have accepted this great responsibility at this critical juncture in the development of engineering in our country in the hope that with your willing cooperation and active support, I shall have enough strength to uphold the traditions of this great Institution.

The Institution

This Institution was established in 1920 and was granted the Royal Charter in 1935. The objects and purposes for which the Institution was constituted were 'to promote the general advancement of engineering and engineering sciences and their application in India and to facilitate the exchange of information and ideas on those subjects amongst the Members of and persons attached to the Institution '.

This is the only recognized body representative of the entire engineering profession in India. In 1935, it had 1,018 Corporate Members. At the advent of independence of India in 1947, its Corporate Membership stood at 2.551, and today it has increased to 5,947. In addition, there are 9,957 non-Corporate Members, bringing the total strength to 15,904. Considering that the total pool of working engineers in the country consists of about 22,000 degree holders and 29,000 diploma holders, the Institution can rightly claim to represent the profession by and large.

It appears to me somewhat incongruous that, even after the country has attained independence, this Institution should continue to function under a Royal Charter of the British

Parliament. I feel that the Government of India should have taken the initiative and substituted the Royal Charter by a Charter of the Parliament of the country. A delay of more than 9 years in this respect cannot be justified under any circumstances. I do hope that with the efforts made by my distinguished predecessors, the Government of India will see its way to set this matter right without any further delay.

Quite often a suggestion is made that we in India should have separate Institutions for the principal branches of engineering on the model prevalent in some countries like the U.K. and the U.S.A. Some professional engineers have already set up separate societies of their own. I have given serious thought to this matter and have come to the considered conclusion that this development will not be in the interests of the profession and the country.

The Institution of Civil Engineers was founded in England in 1828 Civil then meant all engineers other than military. Its membership was then and still is open to all engineers. The American Society of Civil Engineers was founded in 1852 and membership was open to all engineers. Later, increased membership necessitated separate societies for various main branches of engineering. As a result, today there are more than 70 separate engineering societies. During the last 35 years there has been a growing demand in the U.S.A. for an agency through which these societies can tackle their common problems in a more effective and cooperative way. Pages and even books have been written expounding the need for unity. Speaking to the Boston section of the American Society of Mechanical Engineers. Mr. W. Rayon summarized the need for unity in a few simple sentences. He said, 'We want to unite to secure recognition of engineering as a profession and its importance in American economy. We want to have unity for cultivation of ethical practices, for the acceptance of our professional responsibilities. We wish to unite in efforts to raise the economic status of the engineer, not through union labour practices but through sheer recognition of his value. We want to be in a position to defend ourselves against harmful legislation, to have our opinions respected in regard to military affairs and public works. We want to be heard on matters affecting technical education and the registration of engineers.' The case of the American Medical Association is cited in favour of this demand for unity. The medical profession, like the engineering profession, has its sub-divisions of special professional interests. However, the A.M.A. still speaks with authority for the entire medical profession.

The various branches of engineering have become so much interdependent that the growth of one suffers a setback for want of some knowledge of another. There is no doubt that, in these days of acute specialization, every engineer is apt to follow and further his own particular branch. Further, the specialization has been carried to such an extreme extent that the main subject is branching itself into a multitude of secondaries. The branching and sub-branching of these subjects of special study have led the mode technologist into such a dilemma that he is apt to forget the very source of his branch of knowledge. This is, indeed, a process of disintegration which, if not checked, may lead us to a big confusion. It is, therefore, imperative that the technologist, though privileged to pursue his special branch, should try to know what is happening in other branches of engineering as well. Any attempt to shut ourselves in water-tight compartments would deny the essential contacts which are afforded by the Institution at present. By disintegrating ourselves into a number of specialist organizations, we will not be able to act unitedly even in the technical arena. It will not be possible for us to offer our technical service effectively. It is, therefore, of paramount importance that this combined premier Institution should continue to play its vital role in the field of engineering. I would fervently appeal to all engineers in the country, whatever branch of engineering they may belong to. to enrol themselves as members and come into the united fold of the Institution of Engineers (India) and strengthen it.

Engineers, as professional persons, are obliged to devote their time and effort to matters affecting public interest. In order to help the engineer obtain proper public recognition and professional status. it is very essential that the public must know him not only as an individual pursuing a particular profession, but also as a member of an accredited group. The Institution provides the necessary forum through which the public may call upon the individual or the group for the service and help that it needs.

I am well aware of some of our shortcomings. It is for you members and those that are at present outside the fold of this Institution to strive hard for the eradication of these pitfalls and shortcomings and make the Institution worthy of its high ideals.

The total strength of Corporate Members of the American Societies of Civil, Mechanical and Electrical Engineers comes to about 128,000. The three London Institutions of Civil, Mechanical and Electrical Engineers comprise more than 56,000 Corporate and 100,000 non-Corporate Members. The Engineering Institute of Canada, comprising all branches of engineering, has more than double our Corporate Membership. Even the Institution of Engineers (Australia) — a country with a population less than one-fortieth that of India — has as many members as our Institution.

The Institution is fulfilling a very important role in conducting examinations for engineers. All the workers in this field cannot afford the luxury of university education. There must, therefore, be some means of testing the competence and ability of those who are keen to pursue engineering education in the spare time they can find after earning a living for themselves and their families. Such examinations have great significance indeed in a country like ours, where the facilities for university education are very limited. During the First Five Year Plan period 11,360 candidates sat for Section A, out of whom 1,344 were declared passed: and 3,242 candidates appeared for Section B, out of whom 731 were declared passed. Though the number of candidates who obtained engineering graduate level was only 731, it gave impetus to a large number of young men to advance their knowledge of engineering by private study. There is no reason why the Institution should not be able to get considerable financial assistance from the Government of India in extending the scope of this important function.

Some of the junior members of the profession have occasionally expressed that the present membership fees are somewhat on the higher side. It will be remembered that the working of an all- India body like the Institution requires adequate finances for ministerial expenses at the Headquarters and the Local Centres. The expenses in connection with the publication of the technical Journal issued by the Institution have also to be met. The technical services rendered by the Institution can increase only if the finances improve either through larger membership or through grants-in-aid from the Government. I would appeal to the Government of India to recognize the importance of this Institution in the dissemination of engineering knowledge in the country and give a helping hand to enable the Institution to expand its technical activities. This help will be utilized for building up a strong technical library, providing additional facilities for printing of technical papers, and arranging discussions, symposia and seminars for the furtherance of engineering knowledge, so essential for the implementation of the country's development plans.

The Institution provides a meeting ground for engineers of all ranks from various branches. It is these contacts of the younger engineers with veteran engineers of outstanding capacity and calibre in the country that would go a long way in the growth of engineers of tomorrow for tackling the complex problems of engineering and evolving satisfactory solutions. This is one of the most effective ways of propagation of knowledge to posterity. Even a casual exchange in an informal forum provides better training than can be obtained through any other means. More than any, mature wisdom and sound judgment-the vital keys to successful engineering — cannot be — taught by the printed page. Neither can these be sermonized. They are learnt only through the hard school of experience, through discussion, and through co-working with engineers of repute and eminence.

Control of the physical world

There are two equally important elements in human progress. They are the development of spirit and character on the one hand, and the mastery of the physical world on the other. While improvement of character and spirit affords most promising ways for fulfilling the possibilities of life, of equal importance and significance is the mastery of the physical world to provide conditions suitable to live in and effective tools to work with. The element of physical mastery has been deprecated by sages and seers in India for centuries as of a base order. The pursuit of spiritual life has been acclaimed as nobler. But it is essential to realize that both the elements are equally essential to fulfil the functions and purposes of life.

From my extensive travels both in India and abroad, and discussions with eminent personalities, I have found a universal determination of all the nations — whether in Asia or Africa, and whatever their present state of development — to improve their standards of living. Ninety percent of the present population of the world has a standard of living much below that of the United States. Some fifty years ago, an American worker produced roughly the same amount of goods in a day as his contemporary did in any of the countries of Europe. He enjoyed about the same standard of living. Today, he turns out from two to four times as much, and eight hours of work buys for him nearly one-and-a-half to four times as much as that for his counterpart in Europe.

It is admittedly true that the American ways of life and their higher standards of living are not applicable to India. Deep differences of philosophy, of social and cultural outlook, and of national customs enter into the picture. Yet Indians do crave for higher standards of living; they do want less work, more pay, an easier life, more leisure, and some recreation. To this extent Indians are as human and materialistic as any other people. India cannot survive by the pursuit of the spiritual side of life alone. It may lead to absence of development and to stagnation.

Without the mastery over nature, our earth, as it is, would support but a small fraction of the present population. Broad estimates made by experts indicate that the population of the world has risen from 1,100 million in 1850 to 2,400 million in 1950. They estimate that by the year 2,050, the world's population will have increased two and a half times the 1950 figure, reaching a gigantic figure of 6,000 million.

How will the demands for the steadily and substantially rising standards of living of the world population be met? Will the world be plunged into an economic catastrophe? I submit that hunger and poverty are no longer beyond solution. The mastery of the physical world around us gives the key to the problem. The most thickly populated regions on the earth can be satisfactorily fed if the most effective known methods are applied. The technical possibilities of feeding the world will probably always run far ahead of the increase in population.

Research and development in nuclear physics has opened up great possibilities of an alternative source of fuel for generating electricity. Similarly, extensive study, research and development of alternative sources of food supply should be relentlessly pursued. besides undertaking measures for stepping up the agricultural production of the world.

The role of the engineer

As stated by Dr. Arthur Morgan. at every step in the history of mankind, increase of mastery of nature has been brought about by three major factors. Foremost among them is his direct and intimate acquaintance of those elements of nature that are to be mastered. We can seldom control those with which we are not acquainted. The second important factor is understanding. Quite frequently it is the lack of perfect understanding of the several constituent forces in nature that come in the way of optimum utilization. The third is the dexterous use of the hand, ear and eye for increase of the mastery of nature. Even the most brilliant and penetrating theory may become ineffective in controlling the environment and remaking the world without their appropriate use.

Understanding and familiarity with the physical world produce the scientist. Skill of hand, ear and eye produces the craftsman or the technician. Finally. these activities are most effective when they are ably coordinated with one another by creative genius. Such coordination of mind and hand is provided by the engineer who is especially equipped to do so by his education. training and experience gained from a lifetime of practice of such coordination. It is the effective cooperation of the scientist, the technician and the engineer that will meet the increasing demands of the growing population of the world. Already the material world is being transformed and transformed rapidly. But the transformation must not be attributed to pure science alone. An essential element—perhaps the most important element—is the correlating faculty of the engineer. Such developments involve a large element of sound judgment and much cautious trial and error. The laurels for adoption of the discoveries of pure science to the needs of man rightly belong to the engineering profession.

Some call engineering a craft. It is the pride of engineers that they are technicians. While as good technicians they follow a systematic and orderly procedure, they are endowed with the imagination and aesthetic appreciation of an artist to recreate and to rearrange. It does not matter much whether engineering is called a craft, a profession, or an art; whatever the name may be, this study of man's needs and of nature's gifts with a sincere endeavour to bring them together is broad enough for a lifetime of effort and dedication.

Future problems that challenge the profession

Over the last 40 years, engineering has seen many epoch making developments. Science is continuing to provide engineering with ever-expanding vistas. We are rapidly moving into an age of nuclear fission. So far as power resources are concerned. never before had man been so wealthy. We can be certain that our construction methods and plant and equipment will be different and better. We can be certain that our engineers and engineering techniques will continually improve. Some of our future structures may appear fantastic in terms of our present day concepts. The advent of new metals and alloys, the application of nuclear phenomena to other fields, the utilization of the inexhaustible store of solar energy, the harnessing of tidal and wind power. and electronic and mechanical innovations in automation, throw fresh challenges to the engineering profession. What is ahead in the years to come is a question the answer to which can only be surmised. Even the most unbridled imagination may prove more accurate in visualizing the future than any forecast based solely on reason. What part will research play in determining our future? What are the fields in which research will prove most productive? These are intricate questions. No dogmatic answers are possible.

There are some highly stubborn but extremely subtle problems in almost every field of engineering. When and how shall we end the corrosion of structural steel? What will be the wearing surface for our highways of the future? Will such surfaces be truly permanent? Shall our future water supplies come from rainfall caused at will or from the great oceans? Will there be new provisions for disposal of waste? How fast shall we travel? How safe will the journey be? Ever so many questions of engaging interest confront the engineer. There is a rhythm and a sequence. Each question prompts others. These questions with all their perplexity portray the brilliant future of living and the vital role the engineer will play in this great drama to be.

Indian engineers have not lagged behind

The achievements of Indian engineering have been stupendous in the past few years. After the dawn of independence, great strides have been made in the country. Problems that were never heard of confronted the infant democracy. Partition of the country was an essential prerequisite demanded for political independence. Having accepted the inevitable, transmigration of a whole mass of people was a dismal picture that scared the Government. Bold decisions and quick action produced the necessary results. The rehabilitation and resettlement of the refugees have been achieved with a great measure of success. The building programme that followed to house these refugees was indeed praiseworthy. The national reconstruction demanded the construction of huge buildings and multistoreyed structures for Governmental office buildings and other purposes; new highways with incidental bridges, cause waysand other crossings; industrial townships and factories like the Sindri Fertilizers; capital city constructions like Chandigarh in East Punjab and Bhubaneswar in Orissa; and many other structures of marked engineering efficiency such as the Banihal tunnel and the Vigyan Bhavan.

The river valley development in the country is gaining momentum every day. The Tungabhadra and the Lower Bhavani Dam constructions in the South were completed. The first phase of development of the Damodar Valley is almost complete. Two dams, Tilaiya and Konar, and the Durgapur Barrage are already functioning. The construction of the Maithon Dam is almost over and the constructional tempo on the Panchet Hill Dam is gaining rapid pace. The Hirakud Dam with some unique features of design and construction was opened by our beloved Prime Minister on the 13th January, 1957. It is the longest dam in the world measuring about 16 miles from one end to the other. The construction of the 740 ft. high Bhakra Damis progressing according to schedule and will be completed by about 1959. Koyna, Rihand, Chambal, Kosi, Nagarjunasagar, and many more are under various stages of execution. An idea can be had of the magnitude of the river valley project development when we see that the amount spent on them every year is more than what was spent during the entire century prior to Indian independence. The development is exciting and spectacular.

The Indian Railways have registered their landmarks by the construction of the Chittaranjan Locomotive Factory and the Perambur Integral Coach Factory. The engineers of the Army have contributed their mite and showed efficiency in the construction of the Nepal Road — a national highway linking India with Nepal — the Bharat Electronics Factory at Bangalore, and the Machine Tools Factory at Ambernath. No less striking is the development in the branch of Posts and Telegraphs. Carrier current communication has been extended to most parts of the country and further development in the shape of coaxial cables for increasing the capacity of transmission between the main traffic centres is proceeding. Wireless communication including V.H.F. (very high frequency) facilities is being increasingly used.

Free India realized the importance of research in the technological development of the country. Theoretical as well as applied research and technical 'know-how' are very necessary for a marked success. Several national laboratories, technological institutions, hydrorneteorologic observatories, and aerodynamic research stations have been established. As an instance in point I may mention here the part played by the Central Water and Power Research Station at Khadakvasla in taming the Brahmaputra River to save the town of Dibrugarh in Assam. It looked almost certain that the town would be swallowed up by the mighty river. Nothing short of a heroic battle for Dibrugarh was fought, and today I am happy to claim that we have saved the town from further danger. This was possible because of the basic research conducted in the laboratory and the bold action in the field.

On the industrial side too, our development has been no less marked. The Hindustan Aircraft Factory, the telephone industry, the electric cable industry, machine tools, and oil refineries are a few major of the many enterprises. Heavy industries are programmed in the Second Five Year Plan. The stress is more on rapid industrialization of the country though considerable importance is attached to the agricultural improvement projects. The basic iron and steel industry has been given great importance. The Rourkela, Bhilai and Durgapur iron and steel plants are being pursued vigorously.

I must not fail to mention the atomic energy plant at Trombay. This opens up a vast field for the utilization of our extensive atomic energy resources.

We must continue to grow Our past achievements should not make us complacent and dim our vision for the future. In the inspiring words of our Prime Minister, 'Let us think not so much of what we have done but of what we have left undone. Let us think also of the mighty resources of India, which, if harnessed and utilized for common good, can change the face of India and make her great and prosperous. To this great task let us address ourselves with all the strength in us.'

The profession of engineering is as old as the crudest shelter ever built in the antiquated past to protect our forefathers against their foes and the elements. Also, this profession is as new as atomic fission and nuclear fusion. This has been so because of the new environments, materials, methods and problems that are incidental to the onward march of human progress.

What was done yesterday may not suffice for tomorrow. Past practices must be re-examined and re-evaluated. A fresh approach to present and future problems must be made: Present materials must be worked harder, and new ones that are stronger and better must be developed.

We must develop more and more of reliance on ourselves. With this object, it is necessary that Indian engineers are given the opportunity to advance their technical knowledge by specialized study and training to equip them to shoulder greater and greater responsibilities. The challenge of these responsibilities will make them grow. It is my strong conviction that there is enough talent in the country. What is required is a correct orientation and channelizing of available talent on the right lines. A systematic approach, imbued with national fervour. will shake up the existing system and rouse them to action in the service of the country.

In view of the shortage of steel and cement, there is imperative need for taking stock of our present day design practices. I am afraid that many of us still needlessly waste materials by over-designing our structures. Not only do we pay higher cost for the projects in hand, but hold up some other projects for want of these essential materials. Over-design is as much defective as under-design. While under-design results in structural failure and hence has to face public criticism, over-design usually passes off unnoticed in spite of incidental extra expenditure.

There are obvious causes for over-design. Often it is the constant pressure exerted to get the jobs done quickly. The engineer in his haste makes a guess at structural sizes, a guess that is invariably conservative and hence safer. Also the traditional rule of thumb tempts many an engineer to an easier course. Designs and details of old structures are constantly used and re-used. This is an undesirable practice which throttles all attempts at scientific improvement and technological advancement. There is a vital need to review the factor of safety in the light of more standardized materials and more exact methods of analysis.

It is true that many indeterminants still remain in engineering design. Nevertheless, by experience, the engineer should be able to prophesy future trends with a fair degree of accuracy. Steel sections are accurately rolled, lumber is stress graded, and concrete mixes are tested in field laboratories. With an intelligent appraisal of avail, able laboratory data, the engineer can closely approximate the physical characteristics of the materials of construction.

We have now available techniques of design that far surpass those of even the previous decade. Quality of workmanship, while difficult to control, is not a completely unknown factor due to controlled and mechanized methods of construction.

The engineering groups in India should undertake an appraisal of the existing knowledge. They should assess the case histories of thousands of existing structures. Reports of these findings would be an invaluable treatise for ready reference.

Engineers in this country should continually endeavour to keep abreast of up-todate progress made in other countries in their fields. This systematic approach to the problem of making use of what has already been achieved elsewhere in the world is well worth the trouble. Let us once and for all eradicate the evil of guesswork. which results in much waste. out of our design practices.

Many more engineers needed

The work of building up new India devolves on the engineering profession as it did in the building up of new America during the last hundred years and in building up the U.S.S.R. during the last 25 years. If we wish to increase the level of income, there must necessarily be a very big increase in the proportion of engineers and technicians to the working force. About one person in 80 in the labour force in the U.S.A. is an engineer or a scientist. The number of working professional engineers in 1954 has been estimated as 535,000 in the U.S.A. 540,000 in the U.S.S.R. 60,000 in the U.K. and only 25,000 in India.

In this age of atomic energy, the extent to which science and technology have been made use of by a country is the index of its position and importance among the progressive nations of the world. Over the past 25 years Russia has turned out about three engineers for every two in the U.S.A. In 1955, the ratio was about 2:1. In addition to these specialists the Russians are training a vast army of second line technicians.

In 1955 alone, Russia turned out 63,000 engineering graduates. while the U.S.A. turned out 23,000 engineers. During the next 5 years it is estimated that Russia is going to turn out 400,000 engineers and about the same number of diploma holders. In fact, many of the Americans are getting perturbed over this lead of the U.S.S.R. in producing engineers and scientists. Thoughtful Americans have started saying, 'We are not going to increase our rate of progress merely by means of stepped-up appropriations. The greatest scarcity is in the supply of that rare commodity, the trained and creative mind. That is a scarcity that cannot be solved overnight, by Congressional action.'

How does India compare? In 1955, the out turn of engineering graduates was a little more than 3,100 and diploma holders about 6,000. The Technical Manpower Committee appointed by the Planning Commission has given the minimum requirements as about 6,500 engineering graduates by the end of the Second Five Year Plan. This would indicate the leeway that has to be made up if we are to be independent of other countries for all our engineering needs. Some are afraid that a large scale increase in the number of engineering graduates may create unemployment amongst them. There is no basis for such fears.

Even in the United States and the U.S.S.R. where technical training has been carried far beyond the point it has reached anywhere else, there is today a great shortage of engineers. There are 5,000 firms that have recruiting teams in the field in the U.S.A. looking over students who will get their degree this year. The Standard Oil Co. of Indiana has assigned 15 of its top-Right research people to go round the country seeking out engineers and technicians. The General Electric Co. is looking for 2,000 and the General Motors for 900 engineers. The pay grades they offer are quite attractive, with varied opportunities for betterment. The shortage of engineers in India will continue to grow, not diminish. It is inconceivable that a generation hence India will find herself possessing surplus of such personnel. Any restriction on recruitment to small cadres for effecting economy will be highly wasteful in the long run. This is a bitter lesson that the First Five Year Plan has taught us.

If India does not wish to remain contented by being a mere imitator and a follower, it will have to create the conditions which will permit growth in the stature of the scientist, the technician and the engineer. Are the powers at the helm of affairs sufficiently conscious of these needs? Serious disclosures would be indicated by contrasting the total university population with the number of students taking full time courses either in science or in technology.

Is the present climate of India suitable for growth of engineers?

The most important question which must be answered by the country is 'whether the country's present climate is suitable for a bumper crop of scientists and engineers of the right calibre'. You can judge the stage of growth of a nation by finding out which class of that nation, in a particular period of history, was held in honour more than the others. There was a time in Indian history when the Brahmin, as custodian of spiritual development, was held in the highest esteem. India produced sages and seers of the highest order. Then came the period of the warrior, and later that of the landlord.

At the turn of the century, law offered the best attraction. The dispensation of justice in the courts of India depended mostly if not entirely on the ability of the lawyer to present the case of his client. There was plenty of litigation. Big landlords and others from rich families could afford to pay fat fees. High salaried seats on benches of high courts were open to them. In this climate India produced some excellent lawyers, who being free from the chains of Government Servants Conduct Rules, successfully fought the country's battle for freedom.

In the last generation or two in India, the brightest boys looked to the All-India Services. At first, the Indian Service of Engineers was the most coveted and a little later the Indian Civil Service attracted the best of them. These Services brought considerable emoluments and a certain measure of prestige. Consequently, India produced some of the ablest engineers and administrators of law and land. The former have played a significant role in the development of the country and the latter in the maintenance of law and order and settlement of land affairs. In their respective spheres they have discharged their responsibilities most creditably. But for their existence in the cadres, the implementation of the First Five Year Plan would not have been possible.

Then came a big change. The Indian Service of Engineers was abolished along with other All-India Services except the Indian Administrative and the Indian Police Services. The best boys of the country now seek admission to these Services at the cost of all others. If this tendency is not checked, the country shall have to repent as the future development plans will remain only on paper.

I have no quarrel with those who want men of grit and integrity in charge of law and order. But today the country's needs in the spheres of development are even more important.

As recently emphasised by Shri U. N. Dhebar, President of the Indian National Congress, at Indore, 'In the first place the misery of our people call for utmost urgency, and, secondly, the world is marching ahead. Backward as we are, we will be thrown further back if we slacken in our effort.' The dynamic change which is the foremost need of the country, can be brought about only by an army of competent technicians and engineers. This needs a well thought out and long range policy, as the supply of engineers cannot be turned on and off like water from a tap.

My contacts with engineers at various levels in the country indicate that the engineers in general are dissatisfied with their lot. They are concerned with such problems as emoluments, professional standing, social status, and collective bargaining. It is evident that a considerable number of them feel that their profession has not given them the satisfaction it should. Not only members of the profession but also those who are interested in creating a socialistic pattern of society by achieving a more rapid productivity should be concerned about this dissatisfaction. They should determine the root cause of the trouble and try to remove it.

The need of the hour is to attract the best brains in the universities to the development and nation building activities which have to be handled by technical and scientific men. The best interests of the country require that each individual should make the fullest use of his aptitudes and develop them so that he can exercise his capacity to the maximum in serving the country's needs. The climate in the country, however, does not encourage the bright young men to choose subjects which will fit them for technical and scientific careers. Even those who have been trained at great cost in engineering and sciences prefer to go to other careers. It is apprehended that there is a gradual drift towards the arts as compared to the science subjects, in view of the comparatively easier opening provided by the expanding I.A.S. competitive examination to such subjects. This tendency would be detrimental to the interests of the country and will be an obstacle in the implementation of the country's Five Year Plans.

What is the cause of this tendency? It probably begins in high schools and comes to be a decisive factor in the Intermediate classes where the young student has to decide what he wants to be. It is here that he begins selecting subjects to prepare for his future. Attractive compensation very often determines the field, professional or otherwise, to which the prospective student decides to direct his talents. He elects courses that will give him maximum dividends in the I.A.S. competitive examination.

Shortage of technical teachers

The next hurdle is the shortage of competent teachers in our engineering colleges. What can be done to meet this shortage? Let us see what others have done in facing such problems. For example, Bay City, Michigan, had the problem of shortage of trained teachers. A study was instituted with the help of Central Michigan College. They found that the teachers' traditional complaint of a vast amount of unnecessary work was justified. They found that each of their 137 teachers was spending from an hour and a quarter to more than 4 hours every day on a combination of activities which did not require professional teaching competence and could be included in the general phrase 'house-keeping'.

What did they do about it? They instituted a system for the use of teacher 'aids'. These teacher 'aids' took the roll call, checked papers, recorded grades, prepared materials for teaching, gave first-aid, supervised home work-all the dozens of things that take so much of the teacher's time without requiring any of the teacher's special talents.

What was the result? They found that the new system made it possible for the teacher to spend an average of 23% more time on activities closely related to instruction. Many of the original 'aids' enrolled in programmes intended to prepare them to become full fledged teachers. A good deal of the time of engineers and engineering teachers could be saved by giving them such 'aids' to take care of all non-engineering work.

That is one solution. It is not a complete solution, and it may not be the best solution for our colleges. In Ohio there were 3 colleges that were worried about the calibre of instruction in science courses. They, too, hired teacher 'aids'. In addition, they hired 3 top-notch instructors. each a master in his own subject. These three moved from college to college like circus riders. giving each college a level of competence in those 3 courses that it could not have afforded on its own. Obviously, small institutions cannot afford to hire top quality teachers for every course. Perhaps the answer lies in pooling parts of their faculties.

Teachers' pay is certainly an obstacle. It seems one of the paradoxes of our system that we pay all our teachers according to the same yardstick. We should realize that the educational system is not immune to the laws of supply and demand.

In some areas it might be possible to have engineers volunteering to devote, say, 3 hours a week to teach a class in a special subject accepting a suitable honorarium. In addition. we have an increasing reservoir of engineers and scientists who have passed the mandatory retirement ages. but who are still capable of many years of service as teachers. Whatever departmental and codal barriers keep them away from rendering such service should be removed.

Engineers in administration

In technical departments of Government, there has been a growing discontent during the last two decades. Governments have shown distrust in technical administrators. The technical men have a grouse that they are being progressively debarred from taking their share of responsibility at Governmental level and that non-technical administrators have been introduced between the Ministers and heads of engineering departments. Even posts like General Managers of nationalized factories, for which engineers would be best fitted in view of their practical experience and analytical approach to problems. are being filled by non-technical administrators. The general experience is that this results in delays in the execution of national schemes. The coordination between persons in the secretariat and those in the technical services is becoming more and more remote. It is true that one of the great virtues of the Indian system is the emphasis placed on generalist qualifications for officials in top positions. But there is no single source of generalist personnel, no single formula for developing them. Some persons with technical background become competent generalists. Others are capable of transformation into generalists by diversification of their experience. I would accede that some top level Governmental generalists have proved admirable heads of industrial organizations. Conversely, some persons recruited and put through the experience conventional for preparation of generalists, never develop a real capacity for high level performance.

In India sometimes the very word 'administration' is too narrowly conceived as relating to financial and personnel administration, coupled somewhat vaguely with other functions of the secretariat. To quote Dr. Paul H. Appleby, 'Administration is basically the conduct of programmes important to citizens and to the nation; fiscal administration and personnel administration are merely aspects of the general management of a variety of programmes. Administration in India seriously needs a much more marked orientation to the conduct of programmes, because the present 'administration' is largely negative. The system of personnel management contributes importantly to this bad condition'.

In accordance with the socialistic pattern, the Government is entering more and more into industrial and commercial undertakings. The usual pattern of administrative service which was previously meant primarily to keep law and order will not suit the country in the present day context. It will be necessary to change the administrative practices at least in this field. In fact, the tempo of the Second Five Year Plan projects is so great as to require a drastic change in control methods. The difficulties and bottlenecks in the way of successful accomplishment of these projects are so great that vehement arguments are advanced for the wholesale removal of the procedural difficulties, which are only adding to the problem. The need for rapid expansion in the basic projects undertaken by the Government is so pivotal to the success of the Second Five Year Plan that very special measures are justified.

India is, in fact, in a state of emergency quite comparable to the condition that would have obtained if the nation was at war. Its success in this emergency depends upon rapid decisions making rapid action possible. The present emergency is most acute on the front where new enterprises and huge projects are being taken up. As in war, the emergency dictates the establishment of procedures that have a maximum potential of acceleration consistent with the maintenance of democratic values.

One of the secrets of the phenomenal progress of the U.S.S.R. has been that the technical men are given the fullest latitude in their own fields. Even in the U.S.A. more than 40% of persons holding managerial positions were trained as engineers. Since many engineers are expected to rise to the top positions they are developed in an atmosphere which will fit them for their future managerial responsibilities.

It is sometimes argued by the advocates of the *status quo* that 'after all, the index of efficiency of the present system is the achievement being made in various fields' . To these plausible claims, my earnest reply is, 'The fact that the country has progressed 80 far does not prove that it will continue to do so in the future. This progress has been made in spite of the present handicaps, thanks to the momentum gained by independence. It could certainly be bettered: I realize that established systems cannot be changed overnight except through a violent revolution, which itself would hold up immediate progress. In the wise words of Shri Dhebar, .perhaps 'Much can be achieved without formal changes of rules and procedures if the official machinery functions on the basis of trustful cooperation between all ranks of services in place of the present basis of distrust and suspicion. A developmental machinery cannot afford to be coercive of suspicious. It has to function on the basis of trust and cooperation as between equals..... '

Another plea often used to keep the technical men down is 'since experts' opinions are conflicting, the only possible course is to have a layman sit in judgment and decide the issue'. That, I submit, is an attitude of ignorance. If a person with no knowledge of medicine should hear a discussion by medical men in which there was wide difference of opinion, it might well appear to him that since the so-called authorities disagree, one doctor's opinion is as good as another's. Would he himself dare to prescribe any medicine for the patient? Only by having some degree of competence can one distinguish between chemistry and alchemy, astronomy and astrology, or between ignorance and competence in any subject. Only if a person has qualified himself to have opinions on engineering matters will he be able to decide which opinion is better than another.

Occasionally it is claimed that the non-technical administration provides protection to the technical head against public criticism. This reminds me of the parable of the kind hearted elephant who wanted to help the little bantam hen hatch her eggs; so he sat on them for her. Good intentions alone are not enough. In fact good intentions without good judgment might be quite expensive.

Once it is fully realized that the rapid development of productivity is a basic essential for a socialist society, the necessity for technical-administrator personnel both in the public and private sectors would be obvious. Never before was a greater and more urgent need for technically qualified men with the natural gift for management in higher administration. The ideal men for such appointments undoubtedly are those who are qualified in science and technology and who, in addition, have the inborn qualities of character, power for leadership, and that rarest of all senses—common sense—the combination of which earns the respect and confidence of others.

Engineers in policy making positions

I go a step further. I plead that even in country's policy making institutions the engineer trained minds could be more helpful. The technical training of an engineer naturally develops in him the habits of exact thought. The correct analysis of various factors which may cause errors and the attainment of nearly the exact truth are essential procedures in solving engineering problems. It is this habit that would give him a better place in the policy making institutions which have at present a preponderance of members of the legal profession.

A good lawyer when he draws a deed or other legal instrument, quite properly looks backward to follow old and sometimes almost archaic forms. A good engineer on the contrary is constantly alert and endeavouring in the quest for new methods to solve new problems. Intellectual habits thus formed often persist and prevail. The association of more and more forward looking engineers in the policy making, institutions would be an improvement in the present stage of development of the country.

Most of the engineers and technologists shun public appearance. They shut themselves so much in the technical cages of their own creation that today the trend is to use them merely as simple tools. This is a wrong trend and must be resisted. No doubt, the engineer should always strain every nerve for bettering his professional attainment, but never at the cost of social and political segregation. He must assert his rightful place in society and be instrumental in the effective shaping of the policies of the country in which he lives and to the building of which he contributes so much. After all. what is democracy? Is it not the organized effort of a few individuals or groups. convincing the general public for support to a particular programme of activity in the country ?

Engineers should become active in politics not to seek profit or prestige but to seek satisfaction in helping the work that ought to be done. In this modern age of technology such an acceptance of leadership is a special obligation. Machines are important but men are more important. Technological improvements are important but improvements in the art of human relations are even more important.

The texture of economy and culture are rapidly changing as a result of frequent technological improvements brought about by engineers in their technical capacities. Our political and social institutions need also to be improved constantly in correlation with technological improvements. Unfortunately. political and social improvements seem to be lagging behind in this respect. Ethical and human values of life are suffering a setback.

Governments that might have been adequate in bullock cart days are absolutely inadequate in these dynamic days of jet aircraft and rockets. There are great opportunities for engineer trained minds—an inspiring challenge that should be met to assist in solving the new problems in our political. social and economic institutions. problems occasioned largely by too rapid a progress in technical and technological fields.

Our democratic institutions will benefit if some engineers are willing to give part of their time to serving as members of district boards, party committees, city councils, delegations to political conventions. or members of the State or National Legislatures. We want at least a few engineers, not as technical governmental employees of whom, of course, there are now many doing most useful professional work, but in policy forming positions of importance in which, alas, there are at present so few.

I believe that these policy forming political positions are so important for the satisfactory performance of the engineers' professional duties and the percentage of engineers at present is so close to almost nil that every possible effort should be made to encourage engineers to seek to fill them.

Good engineering is important but a good and able Government is far more important. The engineering type of mind is so much needed today to assist in solving the current complex problems by cool rational analysis and sound judgment. This is the most appropriate time for the engineers to awaken and fulfil their civic responsibilities and duties.

Big engineering firms might well assist in making it easier for one of their engineer members to hold a time consuming public office. An older engineer who has been successful enough financially to provide reasonably for his family needs. might well retire from active engineering work and devote the rest of his life to public service. The fact that most such engineers would be serving at personal sacrifice with no personal interest or financial gain would contribute much to the type of objective and clear thinking so much needed for the public good.

Need for self-appraisal

While I believe that the interests of the country demand that engineers should have a place in administrative and policy making positions. I am not so sure if this Institution should be used as a union for promoting the interests of the engineering personnel. Recently the Engineers Joint Council in the United States took a poll of 66,000 members of specific classes as regards collective bargaining. Seventy, two percent opposed collective bargaining for professional engineers; 66% felt that collective bargaining is incompatible with professional status; only 22% reported that they believed that collective bargaining would be advantageous. Conditions of engineer employees in India, both as regards professional and personnel treatment and financial emoluments, are much worse than they are in the United States. Faced with these, some engineers in the country are of the opinion that the Institution might resort to unionization in the belief that tangible results could be achieved only by pressure through collective bargaining. Even though they realize that collective bargaining may not be consistent with their Charter and constitution. they would be willing to submerge some of the principles in their attempt to get better working conditions through union activity. This obviously is a challenge not only to the profession but to those who employ engineers. In the minds of Indian engineers, both in Government and private fields, a feeling is growing that the emphasis to divest them from high responsible positions is on the increase. Unless this situation is rectified, the tendency towards converting professional institutions into unions may be difficult to stop.

This is likely to have an adverse effect on the professional concept of engineers, for a professional man must rely first on his own personal ability and integrity for recognition. Prestige is something that must be won. It cannot be bought or automatically accorded. It is something that one can command but never demand. In the final analysis an engineer achieves professional standing only to the extent that he accepts his responsibility to himself. to his employer. and to society.

There is need for critical self-appraisal amongst engineering circles. One cannot just push himself up the ladder or depend on some one else to pull him to the top. The fact that a man has acquired a Bachelor's Degree of Engineering does not in itself entitle him to any individual lasting recognition. It remains for each individual to prove by his own ability, integrity, and conscientious application to duty that he deserves recognition. Each engineer has some definite responsibilities to his employer. Amongst other responsibilities a true professional engineer must be measured by a certain code of ethics. He must scrupulously adhere to all the prerequisites prescribed in the code. It is impossible to maintain professional integrity without social integrity; the two supplement and complement each other.

Sometimes I have come across engineers who are more interested in having a job than in doing a job. Our Code of Ethics requires each engineer to act for his employer as a faithful trustee in all matters technical or financial, whether the employer is in the public or the private sector.

Another drawback which checks us is the attitude of mind of many engineers in this country. We must guard against the ostrich outlook. We must develop ability to face realities to adjust to changing conditions, and to abandon some cherished idea if it is doomed to failure.

Every one who aspires to administrative positions should have some knowledge of the principles of cost accounting. A fully trained engineer with some of the specialized knowledge of cost accounting at his command should have no fear of being overtaken on the promotion ladder.

The work of a truly professional engineer is so far from the routine established pattern that only he can provide the initiative, the discretion and the judgment to achieve the successful accomplishment of his particular task. Because he alone knows with what comprehensive ability and likelihood of success he approaches his assignment, the professional engineer must accept individual responsibility. Any attempt to use the Institution as a union would compromise our high professional standards.

We, as a body, want and strive to deserve recognition for service to the well being of the masses of our poor country. At this critical juncture of our country's development we want engineers of grit and integrity.

'Men whom the lust of office does not kill
Men whom the spoils of office cannot buy.'

The nation cherishes the fond hope that our Institution would produce such men for the implementation of our development plans. Shall we fail her at this critical juncture?

Jai Hind.'

Shri D P R Cassad

B.Sc., B.Sc.(Eng.), M.Sc.(Eng.), M.ASCE, M.R.San.I., M.M.G.I., M.I.E.,

President 1957-58

Presidential Address

'For the ensuing year the Council of this Institution, representing the members, has elected me to be your President, and I take this opportunity to express my sincere thanks for the great honour conferred upon me. It is obvious that a heavy responsibility has been placed on me by this unique honour by my colleagues on the Council, for I am aware that my predecessors have set a high standard of industry, wisdom and learning to guide the Institution on its onward march of progress. It is particularly gratifying to my sense of pride, excusably so, to have my name associated with those eminent engineers, who in the annals of the history of the Institution, have occupied the onerous office of President. However, in a democratic Institution like ours, the duties and tasks of the President are made easier as the Council and the various Committees of men long experienced and skilled in the engineering profession are ever present to share the President's obligations and duties by advising him in all matters pertaining to the Institution. These duties and responsibilities are made still easier by the Institution's ever-alert Secretariat whose efficiency has stood the test of many years of devoted and loyal service. On this day, I can only assure the members that I shall do my utmost to uphold the high traditions of the office and safeguard the interests of the Institution by progressing its activities in various directions, and see that no efforts, in any shape or form, are spared during the tenure of my office and thus justify the confidence reposed in me.

It is certainly a very difficult matter for the incoming President to give an address. May be I would be better qualified to give this address at the end of my term of office, rather than at the very beginning of it. However that may be, it has been the practice that in every Presidential Address from this forum, frequent and repeated references have been made in the past to the high professional and ethical standards to be maintained by the Institution and its members and this is uppermost in the minds of all those who have the best interests of the Institution at heart. But these standards are closely knit with the basic training of an engineer.

Having spent a number of years in receiving training at the different Universities of Bombay, Banaras and London, or in imparting knowledge of the fundamentals of engineering, I propose to discuss the subject with a certain amount of knowledge that one acquires with the passage of time. I am never happier than when I am in the company of students and it is a happy augury that we have on the Roll of the Institution over 11,000 Students. On my visits to the different Centres to attend the meetings of the Council, I have had some measure of satisfaction in watching them and noticing their characteristic developments. Self-reliance, honest and hard work, devotion to duty, initiative, discipline, humility and self-control are prime factors in the building of the character of a student in order that he may be an asset to the profession to which he has voluntarily enjoined himself. It is vitally necessary for him to pay greater attention to fundamental than to material values, and work for moulding India's destiny in a spirit of disciplined dedication.

Formulated as we are to promote, regulate and elevate the acquisition of technical knowledge for those who have chosen the engineering profession, the Institution affords various facilities for aspiring young men to qualify. This is more particularly advantageous for those students who are not fortunate enough to follow a course of studies in a recognized college or university, and for this reason the Students of the Institution are enabled to qualify in Sections A and B of the Associate Membership Examination in the groups and subjects of their choice in the different branches of engineering. The Institution examinations have shown that a high standard is maintained, and this is a standing testimony to the long and mature experience on the part of the Examinations Committee of the Institution. These examinations are held twice every year at different centres throughout the country, and unless Students have thoroughly imbibed the engineering principles, both in theory and-in practice, it is, indeed, difficult to pass the Associate Membership Examination in Sections A and B.

The Institution is fulfilling an important role in conducting examinations for those already in the engineering profession who for one reason or another cannot afford to pursue the ordinary university engineering education, and the Associate Membership Examination of the Institution is recognized by the Union Public Services Commission and most State Governments for recruitment to the engineering services.

Here, I would crave your indulgence to allow me to say a few words on the history of our Institution. Started as far back as 11th November, 1919, at Calcutta with a small membership of only 138, the Institution was first registered in September 1920 in Madras. The surging need for more and more Centres in different parts of the country was soon felt, and in 1921 the Bombay Centre was formed. Hardly a decade and a half had passed when in September 1935 the Royal Charter was granted to the Institution as a testimony to the strength and inherent qualities of the Institution which were recognized by the Government of the time. With the granting of the Royal Charter, the Institution had successfully got over its teething troubles and saw the culmination of the great and sustained efforts of its Presidents. It may be of interest to learn that at the time of granting of the Royal Charter by King George V, the membership of the Institution stood at 1,262, and since then it has grown by leaps and bounds and today ours is the largest single forum of qualified engineers as well as of students who are qualifying for the profession of an engineering this country.

The total number of members on the Roll of the Institution as on 31st August, 1957, was as follows :

Honorary Members	14
Honorary Life Members	1

Members	1112
Associate Members	5298
Companions	4
Graduates	578
Students	10933
Affiliate Members	21
Subscribers	84
Total	18045

With a view to keep the dignity and self-respect of the members of the Institution, all endeavours have been made at the highest level to incorporate the Institution by a Statute of the Government of India. There is a strong feeling amongst the members that it is unrealistic for the Institution to function under a Royal Charter following the declaration of India as a Republic in early 1950 and the consequent Constitutional amendments. The Government of India are hesitant to consider our request for statutory incorporation and it is not understood why our own democratic national Government should not confer a mark of distinction on an Institution which fulfils one of the most vital needs of the country and which had already merited the recognition of the British Government in the past. We have been spending crores f rupees on our Five Year Plans on engineering projects and on the design and supervision of works which are carried out by engineers who are, in most cases, members of the Institution. The Council of the Institution has already expressed its view that it will be in the best interests of the engineering profession to promote unity and coordination between the different branches of engineering through a central authority with the maximum degree of autonomy for each of the different branches of engineering. Nevertheless, certain new bodies of engineers have been formed recently upholding quite different views. However, the Institution has viewed this from a constructive angle, and in order to eradicate this fissiparous tendency and unite all engineers under a common banner, the Council of the Institution has formed a number of new technical groups for different branches of engineering, the most recent being those in Aeronautics, Telecommunication, Chemical Engineering, Mining and Metallurgy, and Nuclear Engineering.

It can thus be seen that in keeping pace with rapidly changing engineering science and research, the Institution has taken a correct step to create a universal forum and to have within its fold engineers from different branches of engineering. It is only in this way can the seasoned engineer of proved ability come in close contact with the younger generation who will have to solve many complex engineering problems satisfactorily. The vital key to success is wisdom and mature judgement, and this cannot be obtained except through personal experience, discussion and exchange of views and by working with eminent engineers taking part in this great experiment of rebuilding our country.

The development of the country as envisaged in the Second Five Year Plan depends much upon the exploitation of the forces of nature and natural resources by skilled and technically qualified engineers. Industrial progress is only possible through engineers supported by adequate financial assistance and this Institution provides a powerful and effective forum to promote efficiency and better training to engineers without which the unrivalled resources of this vast country cannot be developed to the same extent as in the more advanced countries of the West.

The country has entered into a great enterprise of building itself up, and today, it is in dire need of an adequate supply of qualified engineers, and everyone in this country now recognizes that the development and salvation of the Plans depend upon the training of expert engineers in the country. More than anything else, this dearth of technical personnel has engaged the attention of the Government. Nineteen existing engineering colleges and 41 polytechnics are being expanded to provide 2,458 additional seats for degree courses and 4,370 additional seats for diploma courses. This is in addition to the provision already made in the Second Five Year Plan for the establishment of 5 new engineering colleges, 21 polytechnics, and 3 higher technological institutes. The role of the engineers in the life of the nation and its development is an important one with the ceaseless growth of engineering science, as it has to deal with the growing masses of materials and plant and machinery. We have a system of literary, scientific and technical education, but this cannot be evolved for the proper attainment of our goal without a real humanistic approach. Our Prime Minister has paid glowing tributes to the country's engineers on many occasions and times out of number. In the present world of rapidly changing ideas, the importance of sound engineering training knows no bounds, and the most important factor in achieving economic and national success is the provision, in full measure, of adequate training to students. It cannot, therefore, be overemphasized that without filling the wide gap in training personnel, the problems with which we are grappling will remain unsolved. From available statistics, it is found that there are about 72,000 engineers of various kinds in the country, but in the very near future, say, by the end of the Third Plan, India will require something like five hundred thousand engineers. This, means that the requirements of engineering and technological personnel by 1966 will be on a scale far exceeding the capacity of the existing engineering institutions. There is, therefore, need to give top priority to the opening of more technical institutions in the coming years, to meet the country's growing need of engineers and technological personnel. At the end of the Second Five Year Plan, the annual out turn of engineering graduates is expected to reach 6,000 and of engineering diploma holders to touch 8,000. These figures are far from adequate to meet the future demand for engineers. This shortage of technological personnel can be overcome to some extent if Government chalks out immediately a plan to give a definite technological bias to our educational system in the secondary and university stages. The students should understand that they are living in an age of industrial revolution and they should try to adapt themselves to the changing pattern of affairs. Engineering students must recognize that means are more important than ends in the profession which they have voluntarily adopted. They must be good citizens of the country as well, and must keep pace with the rapidly changing times for the clock of time cannot be put back.

This is, however, not all, and much remains to be done. We in the Institution will be able to keep alive the interest of the profession and lend support to all well considered efforts calculated to improve the training of Indian engineers. The engineers of the country have rendered valuable service during the First Five Year Plan and are now doing so in the Second Five Year Plan. But, it is desirable that the engineers should organize and voice their opinion in the administration of the country in a more concerted manner than hitherto, and they should not be content to be represented in Parliament and in other such assemblies by men who are outside their own profession of engineering. It is desirable that the Government on its part should take advantage of the Institution by referring to it all questions of technical importance and by sending copies of all project plans for expert opinion and that they should pay proper attention to its advice. It is also my earnest appeal to our members that they should freely write papers on what is being done by them and on their proposals for the future. Government could also encourage young authors by offering prizes to the Institution for award to members, as in the case of the Railway Board, and by passing an amendment to the relevant statute to make it compulsory for one copy of all scientific technical literature to be deposited with the Institution Library.

There is a growing need for establishing technical universities throughout the country to control and guide the activities of all engineering institutions, for proper emphasis has to be laid on technical education because the scientists and engineers have to play a very vital role in the national reconstruction. Here, I may mention, in passing, about the high esteem in which engineers are held in Russia. In India, the engineers should be given a place of honour and social status befitting the work entrusted to them.

From one end of the country to the other, the language question has been raging, fiercely, and the University Grants Commission have rightly warned against a hasty changeover from English to an Indian language as the medium of instruction at the university stage, and have suggested that the teaching of English should be given special attention in the pre-university class in relation to the three-year degree course which is being introduced in the universities. The importance of English in the present day educational set-up is very clear to one and all from the recommendations made by this body, that it should be retained and that it should continue to be studied by all university students, even when a change is made in the medium of instruction. If we are to progress, English has to be retained at all costs as a properly studied, second language in our universities, even when one or other of the Indian languages is used as a medium of instruction. It would be very necessary to have text-books prepared on scientific principles, and the first task before the Government of India should be to tackle this problem with the least possible delay. We must remember that there is a very close relationship between education and planning, and the need for approaching this problem in an integrated and comprehensive manner is vital for our national development and the cumulative success of our Plans.

The part played by the Indian engineers in various spheres needs no better testimony than a stocktaking of the great engineering and technological achievements which the country has witnessed, and the Government has not been lacking in recognizing the merit of the engineers in the public sector for the excellent development work carried out by them. It is to be hoped that the engineer in the private sector will also be rewarded for his efforts in national reconstruction. Indians as we are, we are unassuming, and similarly our engineering triumphs also are unostentatious. The outer world has hardly begun to appreciate these achievements owing to the quiet manner by which such works have been carried out. This does not mean that magnificent work has not been done by Indian engineers in the development of the country; they have done meritorious work worthy of their metal and for this reason the country owes a great debt to them.

Engineers in the country, both in the past and at present, are ever at the call of the nation, more especially when they are engaged as now in the implementation of the Second Five Year Plan, and taking active part in the development of basic and heavy industries such as iron and steel, non-ferrous metals, coal, cement, heavy chemicals, and machine building which are spread throughout the country. Government should, in its own interest, acknowledge and encourage in a befitting manner the services rendered to the country by the Indian engineers. Each of those who are present here today from different parts of the country represents some aspect or the other of the engineering profession. Many of them are the officials of great public undertakings, whether controlled by Government or by the private sector, but all aim to attain the common objective of rebuilding a new India for the betterment of the country and the uplift of the masses and their living conditions. We have before us the herculean task of the development of material resources of the country and keeping up the tempo of progress in the establishment of engineering industries in the country. In this context there is one subject which cannot be ignored in the present trend of events, and that is, as the engineers are employers of labour and to a very large measure responsible for carrying out the projects in the Five Year Plans, it will be in the fitness of things if they could encourage and foster high ethical standards in business and the profession in serving society. The fundamental fact that emerges from this is to improve the human relationship in business and the profession. The engineers in charge of projects must take their employees into confidence by sharing this concept by discussing ways and means of increasing their enjoyment of their jobs and productivity and by persuading them to understand that service is the measure of success in a business or enterprise. It is an accepted fact that men work better and feel more that they belong and are a part of things when they know what their organization is doing and how their contribution fits into its total activity.

The socialistic pattern of society to which India is wedded, does not mean mere distribution of wealth, but the raising of living standards with the enthusiastic cooperation of the people, as the Government cannot by itself raise these standards. It depends on the confidence and reliance which we have in ourselves and much has to be done to create enthusiasm among the people, so that they could also plan things on their own after determining their needs and actual resources. The Second Five Year Plan aims at bringing up the national income by about 25 per cent while the First Five Year Plan was conceived primarily to meet the economic difficulties brought about by the war and the partition of India. It is the credit of the First Plan that the national income had increased by Some 18 per cent in the five year period. It is expected that the national income during the Second Five Year Plan will increase from Rs. 10,800 to Rs. 13,480 crores, whilst the per capita income will rise from Rs. 281 to Rs. 330.

Great emphasis has been laid on industry and mining in the Second Five Year Plan and this is clearly brought out by the large sums which are earmarked to be spent during the Plan period. A study of the industrial projects as envisaged in the Second Plan includes the three big steel plants at Bhilai, Durgapur and Rourkela and this clearly shows the pattern of industrial development envisaged in the present Plan. To this must be added the expansion programme for the Tata steel plant at Jamshedpur with new methods of processing and manufacture of steel which are making vast strides at present. It is with deep satisfaction that we watch the progress of these giant steel works. Two hundred Indian engineers are being trained in the techniques of the American steel industry, and this programme sponsored by the Ford Foundation with the cooperation of leading American steel manufacturers is of vital importance to the future of this country.

It should be borne in mind that the responsibility of the design and construction of structures lie with the civil engineer. He has to tackle the problem facing him with utmost efficiency and in an 'economical manner with the available capital. The engineer in public service has to avoid the fixation of public money in non-productive projects, by answering satisfactorily not only the question 'Will it stand up?', but also 'Will it pay?' It is for this reason that the public at large look up to the engineer as the guiding star in the construction of public works.

This does not mean that Indian engineers are infallible or no better methods or tests for soundness of projects can be devised. Above all, the problem of coordinating the various desirable purposes within the national development programme has become exceedingly complex, as has the problem of coordinating the various methods of implementation of the Plans into an integrated system whilst making the best use of the inherent advantages of each medium. It is still an unconquered challenge for the best brains of the country and it is high time this challenge is accepted if we are to successfully complete our Second and the future Plans as well.

Our Government is not lagging behind in obtaining supply of electrical equipments for the Nangal fertilizer project and the associated heavy water project. The electrical equipments will include transformers and rectifiers for a substation for the projects. The first contract, for electrolyzers, valued at Rs. 3.5 crores was awarded early last year to an Italian firm, and this was followed by the award of the second and bigger contract, that for the fertilizer group of plants valued at Rs. 7.5 crores, to a French firm. From this it is evident that the Government has been trying to draw on the resources and technical know-how from as many advanced countries as possible.

In this connection, let me make a passing reference to the shortage of foreign exchange. However acute this may be, the Government does not in any manner wish that the provisions in the Second Plan regarding steel and minerals production, manufacture of heavy machinery, development of small scale industries, etc. should be neglected.

The Rs. 40 crore heavy electrical project at Bhopal has been rephased to ensure the production of switchgear, control gear, transformers and capacitors to fill in the immediate requirements of the country. The rephased project calls for an investment of Rs. 14 crores in the Second Five Year Plan period. This revised scheme will have the advantage of a quicker production schedule thus supplying by 1961 badly needed electrical equipment which would otherwise have to be imported for years to come. An integral part of the scheme is the provision of a training school of engineers and operatives to be employed in the factory. This rephased programme however will eliminate for the time being the manufacture of turbines and other heavy machinery.

The shortage of food grains and their import from different countries of the world has set the Government yet another problem. Their storage has been satisfactorily solved to some extent by the barrel shell type design for grain godowns. The Food and Agriculture Ministry of the Government of India is planning construction of such godowns for storage of 1,500,000 tons of grain. The barrel shell type design has the advantages of better flexibility, better lighting, and possibility of reducing godown space required per ton of storage. Besides this, the new design is expected to save Rs. 1.8 crores on a planned expenditure of Rs. 22 crores, thus saving a colossal amount of structural steel. Having accepted this new design, the Central Building Research Institute, Roorkee, has started a special course for training engineers in the technique of designing it. This kind of problem could have been solved much earlier if engineers in private consulting practice were set the task by Government.

Three more fertilizer plants are also being established, and the capacity of the Sindri Fertilizer Factory is being increased. All these clearly show how much special emphasis has been laid in the Plan on the development of basic and heavy industries and this is where the engineer has to play his important role in the implementation of the targets outlined.

One of the greatest achievements of our time is the construction of the Bhakra Dam for the partial storage of the Sutlej waters to provide increased irrigation facilities. This has already been acclaimed as the world's highest straight gravity dam and the first phase of construction of this dam is nearing completion with the height reaching 350 ft. out of a total of 740 ft. This would provide partial benefits from the project to help the country step up production. Within the next two years, two hydro power units on the left side of the Bhakra Dam will be pressed into service, while the entire project is scheduled to be completed by early 1960. The total storage capacity of the Bhakra Reservoir is expected to be 7,400,000 acre-ft., which will irrigate 1,000,000 acres of land in Punjab, Rajasthan and Himachal Pradesh. This reservoir — Govindsagar — will eventually form a 64 sq. mile lake submerging 366 villages. During the construction of this dam, Indian engineers have picked up the most modern techniques in solving intricate and challenging problems. The Ganguwal and Kotla power stations with two generating units of 24,000 kW in each are nearing completion. Experts and consulting engineers from abroad have already trained Indian engineers to take up similar future assignments of this nature with ease.

Several countries of the world have come to our rescue in the implementation of the Plan. This is highlighted by the $ 225 million American loan to India to meet the immediate needs of the country to implement the Second Plan. During the Plan period industrial metals will be supplied by Canada before June this year, and this would certainly speed up the flow of available aid to India both in materials and engineering services from Canadian sources. This aid would also include a Canada-India atomic reactor, power transmission lines, and railway materials.

During the year under review, the Shetrunji project which envisages the construction of a composite dam across the Shetrunji River needs special mention, and much progress has been made already as for the construction of the dam is concerned. When completed, the project would help to irrigate an area of 80,000 acres. Three other projects at Ukai, Girna and Hatnur in Bombay State are also under investigation.

In the public sector, the Government of India have decided to locate India's first two aluminium plants at Mettur (Madras) and Rihand (Uttar Pradesh) and this is based on the availability of adequate electric power supply in the two regions. Two machine tool prototype factories with West German Government aid are likely to be brought into commission in a few months time. This review of impressive plans for the development of the country are landmarks in our economic reconstruction programme and asserts our determination to press ahead with our plans and to utilize fully our potential material wealth to meet the challenge of the new age.

In 1958, we look back on a century of aeronautical progress which was scarcely perceptible in its first half and which now in the second half has been at such a fantastic rate that it can only be realized when we put before ourselves a few statistics. The speed of manned aircraft has now risen to 1,650 m.p.h., the altitude to 79,000 ft., and the power of a single engine unit exceeds 15,000 h.p., while the weight per h.p. has dropped to 0.14 lb. In a modest way, our Indian aircraft engineers will produce at Bangalore advanced jet aero engines required to power the supersonic Hindustan Fighter on a mass scale before 1960. This phase of jet engine manufacture will give India the lead over other Asian countries in the field of aviation and will also provide for the training of Indian aircraft designers to produce better versions of the existing machines.

From this brief review it will be clear that we are certainly taking advantage of men and materials from several sources for the progressive reconstruction of our country. In this age of revolutionary progress of science and technology we are making very many new things and we are adopting modern techniques to make them. We have to deal with materials of whose nature we could not even have thought till recently. Even familiar items have been changed in a manner that we can hardly recognize them now. In this modern world of progress, human nature has invented a new facet to everything, and to enjoy its benefits the new products and processes enable man to create more efficient factories and better living conditions, leaving us to deal with increasing industrial obsolescence. The new techniques of automation has given us more free time at our disposal, but the fears of unemployment may have to be faced by many. In trying to keep pace with the modern changing world, new jobs are found in many new fields, but all this places a heavy responsibility for giving better training to our scientists and technologists in some measure or form. It is good that new jobs present new opportunities, but there is bound to be disturbance in the routine of living which the human race has experienced from times immemorial. Over all this, the newness gives promise of bountiful plenty — not at some distant date, but right away, as we adapt our modern techniques for our daily requirements, for a better way of life. And it is in this direction that large research activities should be carried on both by Government and by industry. We are sure that in our country not only the Government but industry also will increasingly support research for its own sake and direct it towards improvement of specialized plans.

The chemical industry in the U.S.A. spends more of its income on research than any other industry, and that should be so all over the world. Some of these latest techniques enable us to perform many feats, for example, to mention a few, creating earthquakes artificially, producing diamonds from carbon, turning rock into oil, stimulating clouds to yield rain, etc. Many of the new things, however, are only alternative methods for doing in a better way jobs which have existed for ages. The steady improvement of known substances has not satisfied the ever increasing demands of a roaring age of reactors and rockets. To meet present pressing needs, scientists have gone back to substances which were known to exist, but which were considered too rare for industrial use. Elements like hafnium, gallium, lanthanum, xenon and niobium — vonce little known names — have suddenly become briskly marketable commodities. Building of atomic reactors have brought into prominence zirconium, a metal which was so difficult to handle that industry at one time did not consider it valuable for use.

Speaking on nuclear energy, steady technological progress has been made during the past two years, both in civil developments as well as in the military field, and much information has been released by several Governments on this subject. However, the serious concern over the shortage of manpower is being felt by countries which have undertaken research on this subject. Ore discoveries from several parts of the world in large quantities continued, so much so that the existing concentration plants are hardly able to handle them, and for this reason more are being built. In the UK, a new gaseous diffusion plant for obtaining Uranium-235 was opened at Portsmouth, and the plant at Capenhurst was extended. The U.K. Atomic Energy Authority has also stated that enriched fuel would be available for reactors and the United States was exporting more heavy water than anticipated. Other nuclear metals such as hafnium, beryllium, zirconium and titanium obtained from ilmenite and rutile — both available from the beach sands of Travancore to us in this country for nuclear reactors — have begun to be used in larger quantities for industrial purposes, and these metals will replace steel alloys on account of their lightness and strength.

However, in this branch of scientific development we have not been lagging behind. The first atomic reactor to be built in this country — 'Apsara' — was put into operation at Trombay in August 1956 and this ushered in the nuclear age in Asia. his technical achievement demonstrates the scientific and technical engineering skill in its design, construction and commissioning which took just over a year. On the completion of the Canada- India reactor, we will have an important centre for the training of nuclear engineers and technologists in the various aspects of reactor technology, as top technical and scientific personnel are in short supply. An experimental device called 'neutron choppers' will be installed early next year and would be used for study of Uranium-235 on which the whole atomic industry is based. India is a natural area for developing atomic power on a commercial scale as much of the nation's coal has to be transported up to 1,500 miles to large industrial centres and atomic power plants would solve this problem. It is well known that the 40,000 million tons of coal reserves in the country would be exhausted soon; and so is the case with the oil reserves. Consequently, it is very necessary to develop atomic energy. Half the atomic minerals now used were known for decades and are available as said before in Travancore-Cochin, The discovery of other deposits in the Ranchi plateau is also encouraging. It is no secret that in the very near future, atomic energy would be utilized in industry, agriculture, biology and medicine.

In the field of nuclear energy, Japan seems to have gone a step ahead of others. The Japanese shipbuilders have announced that they will begin building two atom powered ships this spring and this can well be emulated by our shipyards, at Visakhapatnam. The blueprints for a 80,000-dead weigh Hon tanker powered by a pressurized water reactor have already been completed and the keel laying ceremony too is to take place shortly. For this the reactor and enriched uranium fuel will be obtained from the U.S.A. It is stated that steam turbines of 40,000 h.p. will give the 800ft. long, 120 ft. wide ship a maximum speed of 19 knots. The uranium required for this could cost just the same as 18,000 tons of oil, but the atomic tanker would be able to carry an additional 8,000 tons of payload per voyage because an atomic reactor and its fuel require much less space than conventional oil burning engines. These facts are stated only to show how nuclear energy is gradually changing the principles which have been conventionally accepted by us up to now in the different fields of transport.

In this connection, mention must be made of our Prime Minister's appeal at the last session of the Indian Science Congress at Madras to keep science and technology apart from the cold war and politics and it is certainly very timely. But this advice should have been given to the politicians and not to the scientists or technologists for it is the politicians who decide what ends science shall serve. Of course, we very well know that science cannot altogether be separated from politics for it has to be conceded that the advance of science in a large measure depends on what the State does for it. However, our Government has certainly created new facilities for research work in many spheres by opening several scientific research institutions. In spite of all this, let us realize that there is no room for complacency, for India lags far behind Western countries which are scientifically more advanced. To this must be added that our country is again confronted by a serious dearth of technicians, and therefore, there is an urgent need for more and more facilities for research and training and reformation of the administrative machinery to ensure that it does not block the path of progress of scientific work.' Above all, our own economic and social problems should have a scientific outlook in order that we can ourselves evolve an effective and progressive method of planning to meet our special requirements. This is a challenge as much to our scientists as to our economic and social planners and other political leaders. Our present day thinking has been very affected by the launching of the recent Soviet satellite. A new period in history not only of science but of all human culture and scientific engineering knowledge has been ushered as a result of strenuous efforts by a large group of scientists, engineers and technicians.

On the 4th October, 1957, Soviet Russia succeeded in launching its first artificial satellite. This development in the invasion of space spells a transition to cosmic velocities which can overcome gravitation and a prelude to space travel, and towards realization of man's conquest of the limitless expanses of the universe. Every day, we are coming closer to the age of space travel and soon we shall be touring on our nearest neighbour in space, and the moon is our immediate target. We are indeed fortunate in living in a very active epoch of the history of mankind. Let us, therefore, as the followers of the great science of engineering in all its branches unite in a common cause of applying the forces of nature to the service of mankind, and make life less laborious, more safe, more productive, more effective, and more happy. We have the glorious task of securing the country against famine, of increasing he value of its resources by improved road and rail communications, of harnessing the rivers by building dams, of turning its material resources into finished products, and of bringing contentment and plenty to our fellowmen. Let us work together and justify our position by our ardent desire and enthusiasm and quiet work for the welfare of the nation.'

Shri D P R Cassad—a Brief Profile

Shri Dhunjisha Pestonji Ruttonji Cassad, B.sc., B.Sc.(Eng.), M.Sc.(Eng.), M.ASCE, M.R.San.I., M.M.G.I., M.I.E., was born on September 16, 1907.

Shri Cassad was educated at St. Paul' s European High School, Rangoon, and Ferguson College, Poona. He graduated in Physics and Mathematics from the Bombay University in 1931. After a period of research at the Banaras Hindu University; Shri Cassad proceeded to England in the same year on a Exalji Dinsha Oversea Scholarship. He received the B.Sc.(Eng.) degree in Civil Engineering of the London University from the University College in 1934, and the M.Sc.(Eng.) degree in the following year for his research work on 'The Temperature Coefficient in Water Filtration' and 'Rigid Frames'. He subsequently worked for some time in the Berlin University, prior to his return to India.

In India, he joined the Tata Chemicals, Ltd., Mithapur, as Civil Engineer in 1939. In 1940 he joined the M.E.S. as Civilian Engineer, but received an Engineer Commission in the following year with the rank of Lieutenant. In addition to various postings in India, he saw service in Iraq in 1942. In 1943 he was posted as Assistant Professor in the Technical Training Wing of the School of Military Engineering, Roorkee. Two years later, in 1945, he resigned from the Army.

Shri Cassad was appointed Supervising Director, Central Provinces Syndicate Ltd., Nagpur, in that year, and later as Joint Managing Director. The firm carries on business in the mining of coal in the Chhindwara District in Madhya Pradesh and in the mining of manganese ore in its proprietory mines in the Nagpur, Balaghat and Bhandara Districts in the same State, and on a contract basis for the Central Provinces Manganese Ore Co., Ltd., in the latter's mines in the same Districts. The Syndicate also exports manganese ore to foreign markets and does iron ore mining for the Tata Iron & Steel Co., Ltd., Jamshedpur, in their Gorumahisani and Badampahar mines in the Mayurbhanj District in Orissa. Shri Cassad is now sole Managing Director of the Syndicate.

Additionally, he is also Managing Director, Byramji Mining Combine (Private) Ltd.; Bombay, which does manganese ore mining in its proprietory mines in the Nagpur District, and iron ore mining for the T ata Iron & Steel Co., Ltd., in their , Noamundi mines in the Singhbhum District in Bihar; ex-officio Director, Kanhan Valley Coal Co., Ltd., owners of the Damna Colliery in Chhindwara District; Managing Director, Star Ginning & Pressing Factory (Private) Ltd., Nagpur, carrying on business in cotton pressing in Parbhani in Hyderabad State; Chairman and Managing Director, Nagpur Electric Light & Power Co., Ltd., which-supplies power to Nagpur and Wardha; ex-officio member, Executive Committee, Madhya Pradesh Chamber of Commerce & Industries Ltd., Nagpur ; member, Advisory Board of the Indian School of Mines and Applied Geology, Dhanbad; member, P. & T. Advisory Committee (M.P. and V.P. Zone); member, Divisional Railway Users' Consultative Committee, Secunderabad; member of the Council, Indian Roads Congress; and President, Nagpur & Kamptee Parsi Zarthosti Anjuman. He was also President of the Madhya Pradesh Chamber of Commerce & Industries Ltd., Nagpur, for 1955.

Shri Cassad's technical publications include 'Determination of the Temperature Coefficient in Water Filtration' in Water and Water Engineering Journal (July 1936), and 'Typical Design for a R.C.C. Chimney (The Tata Chemicals, Ltd., Mithapur), 320 ft. Height and 12 ft. Diameter' in the Indian Concrete Journal (September 1941).

Shri Cassad joined the Institution as a Member in 1946, and has ever since been intimately associated in most of its major activities. He has been a member of the Committee of the M.P. Centre and a Member of the Council since 1948-49, and was Honorary Secretary of the M.P. Centre In 1950-51, 1951-52 and 1952-53 and its Chairman in 1948-49 and 1953-54.

Shri Cassad's interests include sport, and he is the President of the Madhya Pradesh Table Tennis Association, Nagpur, and the President of the Modi Cricket Club, Nagpur.

Shri Cassad already acted as Chairman of the General Section from July 1954 when Shri K. C. Bakhle (M.) resigned from this office and the Council appointed him to succeed Shri Bakhle. He was elected to the Chair of this Section later and took office in February this year. The General Section comprises all the branches of engineering outside of the civil, mechanical and electrical groups, and its Chairman has thus heavy responsibilities, and the Institution is fortunate in having one of such wide experience and enthusiasm and an eminent industrialist as Shri Cassad at its head, and due to his great interest, the Row of contributions has now been transformed from a thin trickle to a steady stream.

Dr K L Rao

B.E., M.Sc.(Eng.), Ph.D., M.I.C.E., M.I.Struct.E., M.I.E.

President 1958-59 & 1959-60

Presidential Address

(1958-59)

I thank the members of the Council sincerely for electing me to the high honour of President of the Institution of Engineers (India). I enter upon the duties with humility and with the hope that I may be able to serve the Institution in a manner worthy of your trust, the standing of the Institution, and the great men who have unstintedly worked for its foundation and growth.

India, which has just emerged from years of inactivity, has undertaken agricultural and industrial development programmes with attendant technical problems of unparalleled complexity. There is the over-riding problem of achieving selfsufficiency in food and also of gaining an industrial capacity which will enable us to manufacture industrial plant and machinery required for development. It is of the highest importance that India's dependence on other countries in the world should be reduced to the minimum in the shortest possible time. In the modern technological age, it is no longer the occurrence of natural resources that determines the prosperity of the country. It is by the development of resources, hard work, and technical advances and efficiency that a nation can hope to build her wealth and living standard. India being a new entrant, has to do likewise, but at a more accelerated rate than those already in the forefront. In achieving this, professional Institutions like ours can playa large part. The learning and experience of an individual may help him in solving his problems, but they will be lost to the community unless he participates in organized discussions at a professional level. The main advantage accruing from a professional fraternity is that a continuous advance of engineering knowledge and engineering talent of the country as a whole is facilitated.

Technological developments in any country depend on engineering education and research, the organization of the engineering profession, and the continued progress in engineering technology. I shall briefly review the developments in the various spheres in our country.

2. Engineering education, training and research

There has been great expansion in engineering education recently. Before 1947, there were only 32 engineering colleges with 2,900 students and 50 technical schools with 3,700 students, while today the numbers have increased to 75 with 9,500 and 127 with 16,000 students respectively. To achieve the full benefits of the expansion, colleges must be well equipped with adequate apparatus and efficient personnel; otherwise, the quality will suffer and the next generation will be seriously handicapped. India is and will be in continuous need of engineers. Not only will the requirement grow in numbers but in diversification and professional excellence as well. Our engineers must therefore be endowed with high technical competence, vision, integrity and independence.

Quality in the students has to come from quality in the teachers. It is, therefore, of utmost importance that personnel teaching the technical subjects must be given opportunities, if they do not have them already, of working in industry for two or three years in positions of reasonable responsibility. The staff employed in the engineering colleges in the U.K. and the U.S.A. are all men with experience in industry. Added to that, in the U.S.A., members of the staff are allowed one day in the week, besides the summer vacation, to take up consultation work. No part of remuneration on account of this is refundable to the university. Besides, engineers employed in industry give lectures on a part-time basis.

Industrialists in foreign countries have two training programmes, one for technicians or persons coming out of technical schools, and the other for graduate engineers. Similar training facilities must be made available in India also. The proper training of technicians is of equal and urgent importance as they are the non-commissioned officers, so to say, of industry—the very basis on which industrial management is built up. The Institution of Engineers offers opportunities for technicians to come up to the level of graduate engineers, if they so desire, thus encouraging capable and ambitious young men to work up to higher levels in the profession.

Twenty years ago, there were practically no research facilities in engineering at any of the universities in India. Now there is provision for 400 students in the different branches. The Council of Scientific and Industrial Research has 21 National Laboratories. Thirteen hydraulic research stations, the Atomic Energy Establishment at Bombay, the Indian Institute of Science at Bangalore, the Sri Ram Institute for Industrial Research at Delhi, the Textile Research Institute at Ahmedabad, the Railway Testing and Research Centre at Lucknow, and the Forest Research Institute at Dehra Dun are some of the more important research organizations in the country. Research has to be tied up to industrial requirements. In the Western countries, industry builds huge laboratories and absorbs a large number of engineers, giving impetus to the increase of post-graduate students in those countries. Some of the industries in the U.S.A. establish their own research laboratories near the universities, or, alternatively, ask the universities to provide additional facilities near the factories and then finance the research. We have to develop likewise an intensive research programme if we are to keep abreast of the tremendous advances taking place continually in the world today.

The Institution must render practical assistance to its members and the engineering profession in general. The Institution of Civil Engineers (London) maintains a number of rent-free houses and provides monetary assistance to necessitous members and their families, widows and children. In our present state, it may not be possible to do this, but surely we should be able to subscribe and support deserving but poor young men to prosecute their studies.

There prevails a large degree of underemployment amongst our engineers. Oftentimes, graduates are employed in subordinate positions, particularly in southern India. This is as bad as unemployment. Graduates after necessary training must be employed in positions of some responsibility. The organizational structure of the Public Works and other departments has to be altered so that the talent of the properly trained engineer may be put to the best possible use.

Four proposals emerge from the review. We have to set up a separate committee in our Institution to look after and initiate research where necessary, and collect and disseminate information regarding engineering research. Real success can be achieved only if all our members take interest and keep the committee busy with their suggestions.

A group consisting of our members engaged in teaching and others has to be set up to devote themselves entirely to engineering educational problems and suggest solutions in the light of national requirements. This group may be known as the Committee on Advancement of Engineering Education.

The Institution must organize collection of funds to support necessitous young engineers, who would otherwise not be able to prosecute their studies.

A proper appraisal of engineer graduates and technicians is needed, and necessary changes in admission, training and employment, have to be made by the combined efforts of the Institution of Engineers, the All-India Council of Technical Education, and the University Grants Commission, together with leading industrialists. If this is not done, we may be producing a large number of ill-equipped graduate engineers, and it will be difficult to make any changes later if an unsatisfactory pattern of engineering education is set. The Institution should approach the Government to initiate action.

3. Engineering profession

In the practice of the profession itself, we have to evolve the type of men best suited for the socialistic aims of our country.

Planning and investigation

Planning and investigation of projects are mostly done through Government Departmental agencies, except in certain industrial spheres where there may be no trained personnel in the Government to undertake such work. Some instances were there, though not many, in which engineering work was entrusted to foreign firms, although indigenous talent was available in the country competent to undertake the work.

It is needless to point out that planning and investigation of schemes must be done with thoroughness, and all relevant data collected before calling for tenders. This will ensure considerably lower costs. I can quote a simple but effective illustration in support of this. Tenders were called for the manufacture of gates for a barrage without specifying designs. The quotations were far higher than what the inviting authority estimated. Designs were prepared and tenders called again. This time the tenders were considerably lower than before. This is because the tenderers knew exactly what to quote in the second case. Similarly, instead of asking the contractor to guess what the dewatering and diversion works in a river would cost, if, as a result of thorough field tests, some information on the seepage and hydrology of the river is furnished, the contractor would not add costs for unknown factors.

Design and construction

There are different practices in the world regarding preparation of designs and the actual agency of construction. In Communist countries like China, for example, the entire work in all its phases is done by the Government. Even military personnel and equipment are employed to supplement the civilian personnel on a project. Speed is the main objective. Works are completed in incredibly short periods.

In many Western countries, designing is mostly entrusted to consulting engineers except in a few cases. Thus. the dams in Italy. France. the U.K.. and some parts of the U.S.A. are all designed by consulting engineers. Only in special Government organizations like the T.V.A. or the Bureau of Reclamation are the designs undertaken by the Government. In these cases, the advice of consulting engineers is sought on specific problems. Construction is. however. entrusted, in almost all cases. with the exception of the T.Y.A., to contracting firms. This tendency has become more pronounced now. The building of the Glen Canyon Dam, which will be one of the world's highest structures, was entirely let out to a contracting firm for Rs, 52 crores. Even surveying of and marking out the work is done by the contractor. Only work which involves an accuracy of more than 1/100th of a foot is set out by the departmental engineers. Such a high degree of reliance on contractual work is possible in those countries because of the participation of a large number of qualified engineers in contract work. The chief advantages of a contractor's or a consulting organization are the greater degree of valuable administrative freedom than can be had within a Government Department and the opportunity of employing experienced and specialist engineers. In a Government organization, as it exists today, no engineers will be retained in a specialist post over a period of time. There is no doubt that a cadre of experienced contractors will ensure competitive tendering and planned completion of works on target dates.

There is a prejudice in this country against contractor, chiefly due to the old type of contractor being more adventurous capitalists than technical men. Similar was the case in Europe and the U.S.A. The participation of honest, qualified engineers in the profession should initiate a new approach. In India, it will perhaps be desirable, and consistent with her policy, to entrust the works that can be done by human labour to co-operative organizations like panchayats and the Bharat Sewak Samaj. But where specialized technical knowledge is required, the work may be done either through the departmental organization or through contractors. The former is justified where experienced men in the line are available in the department. The employment of technically qualified contractors means additional experienced staff on a work. Stipulating the percentage of profits, offering of a bonus for doing work below estimated rates, and recognition for good work done may be some of the measures that can be adopted to ensure the growth of a healthy type of contractors. It is recognized that the formation of a contractor's cadre of the type we want is difficult, but is nevertheless possible. The Government have recently started a contracting concern under the name of the National Project Construction Corporation. This is a good beginning towards the creation of an ideal type of contractors' class, but to achieve success, it will be necessary to ensure that the administration of the Corporation rests with a non-governmental or semi-autonomous organization, and a keen competitive spirit is built up from the beginning. If the Corporation feels that it is a Government concern, it will be no better than a department doing the construction.

Similarly, future development in India calls for the development of indigenous consulting engineers, as a guarantee against continued dependence on foreign technical talent. Large sums of money and valuable foreign exchange are being spent on payments to foreign consulting engineers and their firms in the absence of a large body of consulting engineers in India. A consulting engineer has a very useful role to play in the engineering development of a country. He has the advantage that he keeps himself abreast of all the latest developments in the engineering sciences including research, and becomes in the process a specialist. He is familiar with the practices and economies achieved in different countries. Free from files and routine administration, he can devote all his time to scientific pursuits. Consulting engineers, if developed in the different branches of engineering, will represent the nation's engineering talent.

There are already quite a few consulting engineers, specially in structural engineering and building, most of whom are, happily, members of our Institution. This is however not enough. There must be consulting engineers in other branches like harbours, railways. transport, dams, public health. power generation, etc. Retired engineers from the Government services can also usefully join the consulting firms with benefit to the profession and the nation at large.

In the beginning, till a proper cadre of consulting engineers comes into being and proper conventions are built up, the Government will have to encourage consultation work by establishing a convention of seeking advice from Indian consulting engineers in all cases, whether a foreign consultant is employed or not, and arranging for their close participation in the important projects of the country. In a few special branches like design of river valley structures which may not attract consulting engineers freely, semi-autonomous bodies may be set up to develop as national design organizations in the respective fields. A clear-cut Government policy will be of aid, so that the profession may develop on the best lines suited to the country.

4. Review of progress in engineering

Mechanical Engineering

Progress in mechanical engineering will be a direct measure of India's coming of age. Starting practically from nothing, to catch up with the gigantic advances made in the Western countries. India will need years of patient and hard work. She has excellent machinists, fitters, and other mechanical personnel. What she lacks is men of the foremen class and engineers with experience and knowledge of industries. The shortage of steel which was hampering progress will shortly be made up by the new steel plants going into operation. With all the handicaps, India is making great efforts to improve her mechanical competency.

Workshop machinery like large lathes, grinding and milling machines are now made in the country. The machine tool industry is progressing rapidly. Mild steel welding electrodes of good quality are made. Steps have. been taken to build up a heavy mechanical engineering industry, and it is proposed to set up manufacture of heavy machine building and mining machinery in the public sector in addition to schemes in the private sector. Plans are being prepared to manufacture cement, sugar, jute and other machinery.

Attampts are being made for th manufacture of sulphuric acid, caustic soda, rayon, etc. There has been considerable increase in the production of light mechanical engineering industries like sewing machines, cycles, machine screws, etc. Automobiles are being produced at the rate of about 34,000 a year. Stationary Diesel oil engines of small horse-powers are bing exported. Manufacture of air compressors has been started. Thus, we see India making a beginning in industrial production. The capacity of Indian engineer to achieve, provided facilities are given. is best illustrated by the great advance mud by our railway engineers in the development, design and manufacture of steam locos and wagons. The average tractive effort of a B.G. steam locomotive was increased from 26,000 lb. in 1939 to 30,600 lb. in 1957 by improved design. Boiler pressure was increased by 15% by providing a wide fire-box, Similarly, the tractive effort of a M.G. locomotive was increased from 15.000 lb. in 1938 to 17,400 lb. in 1957. The Chittaranjan Locomotive Works now turns out about 170 B.C. locos a year, while about 100 M.G. locos a year are provided by the private sector. Imported content in their manufacture is getting reduced. For B.C. locos. provision of roller bearings to wheels of locomotives has been started. This will eliminate hot boxes and reduce the frequency and amount of servicing.

Similarly, by redesigning high capacity B.G. bogie wagons to give a loading intensity of 2 tons per lineal foot instead of 1.45 tons. maximum transport of goods with minimum strengthening of tracks and bridges will be realized. Since heavy loads such as ore wagons cannot be handled by the existing screw couplings with side buffers, centre buffer couplers arc being adopted. The entire requirement of wagons will be met by indigenous manufacture, which now stands at about 20,000 wagons a year with plans to increase to 30,000 in a few years.

Steel coaches will replace the timber bodied coaches to secure greater resistance to damage in case of accidents. While in the case of M.G. the steel coaches are to the conventional design of a steel body on a separate underframe, on B.G. the integral design has been adopted which results in a weight saving of 7 tons per coach. The new coaches will all be fitted with roller bearings. The Integral Coach Factory at Perambur, Madras, has made great progress and will turn out 400 to 600 coach shells a year. The imported content in the shell as produced at present is 30%, but with progressive development, integral coaches will be made entirely from indigenous materials. With an output of 180 B.G. coaches a year from the Hindustan Aircraft Factory (to be increased to 300 coaches in a few years), and 300 M.G. coaches a year from the private sector, the demand will be fairly met. Thus, railway engineers are achieving self-sufficiency in the matter of steam locomotives, coaches and wagons which is indeed creditable.

In aeronautical engineering, we are unfortunately far behind. Leaving the Hindustan Aircraft Factory. there is no other factory doing anything for the production of even a part of aircraft. apart from the non-structural parts. The only way toovercome the initial fears and difficulties is to start immediately with the manufacture of small aircraft like trainer aircraft and primary helicopters.

Electrical Engineering

In recent years, some progress has been made in the manufacture of light electrical machinery and appliances but still tremendous headway has to be made in this field as well as in the manufacture of heavy electrical equipment on which no start has been made. The annual output of a few important items and their requirements in 1960-61 are given below:

Item	Annual production in 1956	Estimated demand in1960-61
1. Transformers 33 kV and below	900,000 kVA	1,600,000 kVA
2. Electric motors 200 h.p. and below	360,000 h.p.	1,172,000 h.p.
3. Electric fans	320,000 nos.	600,000 nos.
4. Storage batteries	300,000 nos.	425,000 nos.

In respect of the above and other items of light equipment, the private sector which is concerned exclusively with their manufacture has been making good progress according to the targets laid down in the Second Plan, and it is hoped that the targets for 1960-61 would be realized in practice. However, when we look to the field of heavy electrical equipment, it presents a sad story. Equipment worth crores of rupees is being imported every year and is still on the increase. Alternators to the value of Rs. 156 lakhs were imported in 1950-51, but in 1956-57, the value of imports rose to Rs. 287 lakhs. Similarly, the value of imports of switchgear and controls has risen from Rs. 370 lakhs to Rs. 655 lakhs in the same period. Most of the other items also show the same order of increase.

It is quite apparent that in the context of the acute foreign exchange position, it would not be possible to sustain large power development programmes unless indigeneous manufacture of heavy electrical equipment is undertaken. It would be of interest to mention that even some small countries like Yugoslavia have developed sizeable industries for the manufacture of heavy electrical plant and equipment during the last ten years. According to reports, China is also making great strides in this field. It is a matter of regret that we have hardly made any progress in this sphere. It is therefore of utmost importance that the proposed heavy electrical factory at Bhopal should undertake a much larger programme and include such vital equipment as prime movers. rotating machinery, etc. Unless this is done, it is obvious that the pace of power development of the country will seriously suffer.

Telecommunication Engineering

In the field of telecommunication engineering, a start has been made in the manufacture of equipment. Local exchange equipment required for an annual increase of 30,000 lines are being produced in the Indian Telephone Industries at Bangalore. The required cables are being manufactured at Rupnarainpur at the Hindustan Cable Factory. Automation is replacing manual operation of exchanges. The big cities of Bombay, Delhi and Calcutta are being linked with coaxial trunk cables. The total length of the cables will be about 2,000 miles. The coaxial cable project would provide up to 960 simultaneous conversations over the same conductor.

Regarding advances in telegraph transmission, one switching station has been opened in Bombay which automatically routes telegraphic messages coming from different cities into Bombay to their ultimate destinations. Automatic teleprinter exchanges are being introduced and the Government propose to set up a factory for the manufacture of teleprinters.

Production of radio receiver sets in the country is necessary for a large scale development of broadcasting. This would require the development of valve and transistor manufacture.

Chemical and Industrial Engineering

Chemical engineers are key men for industrial development. The design and fabrication of plant and equipment for industry are based on modern scientific and engineering knowledge. As industry develops, the importance of chemical engineering in relation to professional advancement also grows.

Industrial engineering is a new branch of engineering discipline. It is concerned with the design, improvement and installation of an integrated system of men, materials and equipment. This is known 'as production engineering' in the U.K. and is extensively taught in undergraduate and graduate courses in the U.S.A. Some of the technological institutes established recently by the Government of India provide postgraduate courses in industrial engineering. The services of industrial engineers are specially essential to achieve high productivity.

The Institution has to pay particular attention to the specialized branches of chemical and industrial engineering and promote their advancement as industrial growth can be accelerated only by the presence of adequate and well equipped chemical and industrial engineers.

Civil Engineering

Aerodromes and Buildings: In addition to the existmg 85 civil aerodromes three more at Ratnagiri, Dehra Dun and Kulu Valley are being taken up. For the operation of jet aircraft, the runway at Santa Cruz, Bombay, is being extended at a cost of nearly Rs. 3 crores. Similar extensions or new constructions will be done at Delhi, Calcutta, and other places.

Urban housing factory construction and construction of important multistoried office buildings are in progress all over the country. The problems of rural housing and evolution of a low cost house using indigenous materials have yet to be solved. Chief innovations made are prefabricated type and shell roof type foodgrain godowns.

Public Health: Urban and Rural Water Supply and Sanitation Schemes: A sixth of India's population lives in urban areas and the balance in about half a million villages. In urban areas, 75% lack protected water supply, while 85% lack the amenity of a sewerage system. Even in places where they exist, the facilities are inadequate and need substantial additions and improvements. For the rural population, practically no headway has been made. It has been estimated that nearly Rs. 1,500 crores would be required for a substantial improvement of the situation, of which expenditure on urban schemes would be about 55 to 60%. The present Plan provision is Rs. 91 crores, out of which provision [or rural areas is about a third. The total expenditure during the first three years of the Plan will be less than a third of the Plan provision, showing that in respect of water supply and sanitation there does not seem to be a determination to overcome the difficulties. As recommended by the Third Conference of Public Health Engineers held at Delhi in October 1958, it is necessary to set up Regional Water and Sewage Boards vested with statutory powers at least in urban areas to raise loans and prosecute water supply and sanitation schemes on a self-paying basis. The setting up of the Public Health Engineering Research Laboratory at Nagpur will also be of great help in developing economical methods.

Ports: With the completion of first-stage development works in the five major ports of Calcutta, Bombay, Madras, Cochin and Vishakapatnam, the capacity to handle traffic has increased from 20 million tons a year in 1951 to 27 million tons in 1956. At Kandla, four deep water berths were completed and an additional two berths are being taken up. Nearly Rs. 80 crores are being spent on further development of major ports. There are 150 minor ports of which 18 are considered important, and development is planned for them at a cost of Rs. 5 crores. About Rs. 4 crores is being spent on the construction of new lighthouses and modernizing the existing ones. When we remember that London and New York handle 72 and 132 million tons annually an d that India possesses a long coastline, we realize the great headway that has to be made before there is adequacy in respect of port facilities.

Roads: At the end of the Second Plan, India will have about 380 thousand miles of roads, of which 38% will be surfaced roads. The utter backwardness in this direction is shown by the table below, which gives comparative mileage of roads for one sq. mile of territory and for 100,000 of population in a few countries. Also, the large percentage of unsurfaced toads will require upgrading; even the surfaced roads will require widening and thickening to meet modern heavy truck traffic. Thick and wide pavements on firm bases will have to be built to enable quick truck traffic on the main roads. New roads have to be constructed in hilly regions and backward areas not only to develop these areas but also to ensure transport of fruit and other produce grown in the interior to reach the markets. Roads are being used more extensively as in European countries for the conveyance of most goods within a radius of 250 to 300 miles of the large cities like Delhi, Kanpur, Madras, etc. In the development of national highways, a number of bridges have to be constructed. During 1958-1959, nine bridges were completed, and another ten ate expected to be completed in the current year. A number of large and important prestressed concrete bridges such as at Gowtami (7,600 ft.), at Garhmuhkteshwar (2.308 It.), and at Tiruchirapalli over the River Kaverv (2,070 ft.) are in progress. The works are delayed for want of foreign exchange to import high tensile steel and to pay royalty for using locking devices. There are proposals to manufacture high tensile steel in one of the Indian steel plants, but our engineers have yet to develop a system of their own for locking the prestressed wires.

Name of country	Road mileage per sq. miles of territory in 1955	Road mileage per lakh of population in 1955
U.S.A.	1.00	2,021
France	3.04	1,508
Great Britain	2.00	374
Spain	0.37	258
Ceylon	0.38	119
India	0.25	82

Railways : To the 34,000 miles of railway lines. 700 miles are being added. Other works in progress are: 1,200 mile's of doubling, remodelling of 50 major' yards. and construction of 200 new stations. The construction of the 6,000 ft. Ganga bridge at Mokameh and the 2.000 ft.

Gandak bridge are going well. Preliminary work on a bridge across the Brahmaputra near Gauhati is in progress, The bridge across the Yamuna at Delhi is to be taken up separately. Electrification of 1,450 route miles, now in progress in eastern India, is one of the largest projects undertaken on the Indian railways. The railways are maintaining a steady progress of work incorporating technological advances such as long welded rails. prestressed concrete girders, concrete sleepers. etc.

I shall now review the progress in river valley development at some length as it is the subject with which I have been closely associated for many years.

River valley development

The river wealth of India is the richest treasure that the country possesses. Each year 1,356 million acre-ft. of water flows down the numerous rivers of this subcontinent, from the southern tip of India to the Himalayas. Each river is valuable.

The small River Tamraparni in the extreme south of India with its annual flow of one million acre-ft. confers as great benefits as the Ganga with its 400 million acre-ft. of 'liquid gold'. We are today utilizing only 100 million acre-ft. of the water in our rivers. Sir Arthur Cotton, the great foreseer of India's river development, stated that in waters uselessly going to sea agricultural wealth was being wasted. Huge forces of water must necessarily in flood times be engines of destruction. or, in times of drought, if not used, a loss which could only cause famine, distress, disease and death. On the other hand, they could be made productive of unlimited blessings and prosperity. India's deficiencies in food and power can be completely made good if we develop our rivers and put them to use.

Our inadequate food production needs emphasis. Generally, per capita figures are deceptive, but in the case of food they are realistic as each man requires food. The per capita food produced in India is 0.17 ton as against the world's average of 0.35 ton (excluding the U.S.S.R. and China). The U.S.A.'s average is far higher, being 0.77 ton. It is an imperative necessity that the food production in India should compare well at least with the average for the world if not with the production in relatively more advanced countries. It is no wonder that with our meagre production we have been forced in recent years to import every year 25 million tons of food worth Rs. 100 crores. The deficiency is not due to the backwardness of the Indian agriculturist, who is painstaking and hardworking and has been practising cultivation from ancient times. The factors responsible for the low production of food in India are therefore to be carefully considered. The foremost among these is want of water on land almost in every part of India. The rainfall in India averages about 45 in. There are places such as Cheerapunji in Assam with more than 600 in. of annual rainfall, yet there is inadequate water for crops when needed. One of the problems at Cheerapunji is to find drinking water for the few inhabitants resident in the locality in the non-monsoon months! Rain in India occurs during four months, and even this is not equally distributed. Also, at any place, it varies from year to year. Fields located in Assam or Bengal or where the annual rainfall is between 70 to 100 in. require irrigation as also the fields in Rajasthan or Rayalaseema where the rainfall is less than 20 in. Added to this, some soils as in Assam are sandy and the rain water is not retained.

The irrigated area amounted to 29 million acres out of a sown area of 202 million acres at the beginning of this century, when the population was 236 millions. Before the Plans, the irrigated land increased to 51 million acres out of 300 million acres sown, while the population went up to 362 millions. In the sown areas, the area under food crops in 1900 was 90%, while in 1951 it was 80%, showing a reduction in percentage in the area under food crops. The area under food crops increased by 33% against a population increase of 52%. The food shortage must therefore have been greater but it is only about 4%. This is largely due to greater food production as a result of increase in irrigation from 26 million acres to 45 million acres of foodgrain area. It, therefore, follows that increase in the irrigated area should continue to be the most important factor in our efforts to raise food production.

Irrigation in the past was done by river channels, tanks and shallow wells. Before the Plans, the land irrigated by river channels was only 40% of the total. We can roughly divide the land irrigated by river channels as major irrigation and the land irrigated by other means as minor. Both 'major' and 'minor' irrigation are equally important, just as 'major' and 'minor' bridges on a highway help us in equal measure to reach our destination.

We should attach great importance to the proper maintenance of the irrigation systems and specially the minor ones as they are apt to to be forgotten. The ancients were wise when they laid down that restoration of a breached tank acquired merit fourfold of that which accrued at the time of its first construction.

Regarding further development in the respective categories, we must carefully analyze the relative advantages. Minor works take less time, labour and capital. They can be spread out in the various parts of the country and more people will become conscious of the development works. However, one great disadvantage has to be recognized. The tanks fail to store water when there is failure of rainfall in the locality—at the very time when the tank is most needed, It is, therefore, necessary that channels must be based as far as possible on river systems with unfailing supply of water. Even in a 'drought' year, a river will carry water which can be used to great advantage to preserve the crops which otherwise would fail. Years of greatest distress were often years of considerable rainfall. Thus, though in 1877 the rainfall was heavy, it was the worst year of suffering for south India. In May that year, 21 in. of rain fell in two to three days. Well water has no manurial value. while even the peninsular rivers like the Godavari and the Kavery restore the richness of the soil from year to year. This is why in spite of centuries of cultivation, the Tanjore delta is as fertile as ever.

Following the great impetus given by Sir Arthur Cotton's example in 1836, many weirs utilizing the run of the river have been constructed. Weirs represent the cheapest structures that are built in exploitation of river Rows. There are not many more weir works remaining to be undertaken. Perhaps Bhaislotan weir on the Candak, Broach on the Narmada, and Pochampad on the Godavari, may be a few of the remaining structures that have to be built to utilize the run of the river. Most of the other projects I require construction of storage reservoirs. This would mean enhanced costs and longer periods of construction. Ten years may be taken as the upper limit for the period required for the completion of any major project and the commencement of the benefits of irrigation. This period can be shortened if considered essential. But ten years is not a long period in the development of a nation. Benefits once achieved last for centuries and serve as an insurance against shortfall in food. Future generations can concentrate on other problems and achieve greater success without being constantly faced with the necessity of purchasing food from outside. Irrigation is the most crying need of the country, beautifully described thus by Sir Arthur Cotton, 'India is like the field after an Indian battle; there is but one cry 'water, water'. All that is wanted is water, and this want supplied, everything else will almost follow of course. Water for irrigation and water for transit will provide for everything else'.

Irrigation development in First and Second Plans

Four hundred and seventy irrigation and multipurpose projects were included in the First and Second Plans. Of these, 120 works cost more than a crore of rupees each. Except for some major works like Bhakra, Nagarjunasagar, Kosi and Chambal, most of the works of the First Plan are nearing completion. Progress on Second Plan projects is rather slow. Projects like Tawa and Kangasvati are yet to be sanctioned. The irrigation potential created so far by new projects is only a sixth of the total potential of 39 million acres that will be obtained after completion of the projects. Thus, it will be seen that we have still to do a large amount of work before benefits can be reaped. But there are loud criticisms in some quarters that irrigation works have failed to achieve the benefits and almost a 'go slow' policy is advocated. Criticisms are always bound to be made whenever great works are undertaken. Sir Arthur Cotton's Godavari works, which later proved a splendid success, were considered a gigantic swindle. Sir George Campbell, the then Governor of Bengal, took pride in preventing Sir Arthur Cotton from proceeding with the Ganga Canal taking off from Rajmahal to supply head waters to the River Hooghly to maintain Calcutta harbour, a scheme which is a forerunner of the present Farakka Barrage. He said, 'I was perhaps a little afraid of once letting in Sir Arthur Cotton and his schemes, for I did not know when we could get them out again'. Similarly, opposition to Sir M. Visveswaraya's Bhadravathi Iron Works, Sir C. P. Ramaswami Aiyar's Pykara scheme (then often ridiculed as a 'pythyakara' or 'mad' scheme), and the Hirakud project are more recent examples of severe opposition to good projects. Mistakes in and failure of a works here and there are not impossible, but they should not deter us from achieving the objective, just as an accident on a railway does not lead to giving up of railway construction.

Fears are expressed in some quarters that irrigation causes waterlogging. By waterlogging is meant 'permanent rising of the water table in the ground'. Presence of water in low depressions due to excessive rains should not be classified as waterlogging as is often done. Except in the Punjab, waterlogging is practically absent in the rest of India, in spite of century-old and even more ancient irrigation. In the Punjab, conditions prevail favouring waterlogging. Due to scanty rainfall, there are not many deep and well established natural drainage courses. Even the few that exist are blocked in many cases with extension of minor irrigation. Also, the State is traversed by roads, canals and railways, which also cause partial obstruction to the drainage. Irrigation has been developed quite extensively. At the end of the Second Plan, the percentage of irrigated to cultivated areas will be more than 60%, which is nearly twice the percentage in most of the other States. Also, there is a large amount of perennial irrigation. Thus, simultaneous intensive irrigation throughout the year and absence of adequate drainage are the main reasons for waterlogging. As these factors do not occur together practically in any other region, waterlogging need not be considered as a sequal to irrigation.

Future irrigation developments

After completing the projects included in the First and Second Plans, which will take another five to ten years, the total irrigated land excluding areas developed under minor irrigation will be 90 million acres. Under minor irrigation, it is stated that 9.5 million acres were brought under irrigation in the First Plan and another 9 million acres will be brought under irrigation in the Second Plan. It is probable that these areas include repairs to some old works. Out of the total acreage of 315 million acres, we should irrigate at least 50% before we can be sure of food production even in drought years. To bring this about, major as well as minor projects must be undertaken. Some of the important projects yet to be taken up will be as follows :

1. Linking the Chenab, Ravi and Beas with the Sutlej.
2. A storage project on the Yamuna.
3. Storage projects on the tributaries of the Ganga, viz., the Karnali Kamla, Bagmati, etc.
4. Linking the Narmada with the Mahi and the Sabarmati up to the Rann of Kutch.
5. A storage project on the Narmada in the upper reaches.
6. Linking the Godavari with the Krishna, Pennar and Palar.
7. Jayakwadi, Pochampad and Inchampalle projects on the Godavari.
8. Upper Krishna, Bhima, Sresailam and Pullichintala projects on the Krishna.
9. Projects on the coastal rivers in the east and the west such as the Yelleru, Yerrakalva, Barapole, Pambiar, etc.

It is important to note that we cannot have an indefinite expansion in irrigation. There are other factors such as improved methods of agriculture, use of manures, and change of crop patterns to produce increased food. Thus, of India's sown acreage, food crops are grown on 215 million acres. Wheat and rice account for 46 million tons, out of a total of 65 million tons. In the U.S.A., out of 132 million tons of foodgrains produced, wheat and rice account for only 27 million tons, and the rest is maize, barley, etc. In these methods, there is a reserve for increased production. But it is desirable to conserve at least a major part to the future to give a chance to our following generations to realize the situation and take steps to check the growth in population which they can do more effectively as they will be largely employed and have a higher standard of living than at present. Also, there are nearly 100 million acres of fallow and waste land that can be cultivated. To utilize this, however, it would be generally necessary to develop irrigation.

Costs

Irrigation works involve considerable outlay and do not yield appreciable percentage returns. But the indirect benefits to the community on account of irrigation are overwhelming. The country where irrigation is practiced assumes a different pattern of prosperity altogether. A distinguished engineer, when discussing about costs on famine works, remarked, 'It is true that irrigation works near Bombay pay only one percent, but do famines pay one percent profit?'

When we have to make up for the many years of inactivity, according to the prevalent practice, we have to invest huge amounts of money which we do not have. If people realize this conflicting situation, alternate methods of co-operative effort utilizing human effort can be developed. It may be that in irrigation canals the Government may do only the masonry structures, while the people of the district undertake to construct the canals. At the moment, in some localities, people are asking for even field channels to be dug by the Government. This is a highly detrimental move in the opposite direction and has to be resisted. A respectable percentage of water potential created is being utilized. If, in a few places, there is a delay due to unanticipated reasons, Government may help, but, otherwise, education of the people to the situation in the locality must be the only means adopted. To complete most of our projects at the earliest, we may give preference to undertake projects for which people come forth eagerly to participate.

Power development

At the beginning of the century, India was one of the first countries in the world to produce hydro power and transmit it over long distances. From an installed capacity of 4,500 kW in 1902 at Sivasumudrum, it rose to 2.3 million kW in 1951, and has now risen to about 4.2 million kW. It is anticipated that, by 1961, the capacity will go up to 5.9 million kW, and to 13 million kW after another five years. The country's hydro potential has been estimated at about 40 million kW at 60% load factor. Also, the country's coal reserves estimated at 40,000 million tons will be sufficient for the generation of considerable thermal power Still, in spite of our resources, we are far behind in power development.

The total energy produced in the country is 11 billion kWh out of a world's total of 1,550 billion kWh. Even a small country like Switzerland produces 4 billion kWh more than India and is now engaged on building the world's highest dam—the Grand Dixence—to produce more power.

Important changes in the pattern of utilization are taking place now and these are bound to affect the future development of the power sector. Industry, as is well known, accounts for over 75% of the total electricity consumption in the country; the textile industry ranks today as the foremost user with a consumption of about 1,600 million units, the iron and steel industry being second with a consumption of about 800 million units. However, when the major industrial expansions under the Second Plan are completed, both the iron and steel industry and the fertilizer industry—an insignificant consumer today accounting for only 120 million units—will consume as much electricity as the textile industry at that time, i.e., over 2000 million units. On the traction front, where less than 2% of the total energy consumed today is in the form of electricity, it is being found that, in areas of intensive traffic, it would be cheaper and more desirable to expand on the basis of electric traction than with conventional steam traction, and major programmes of railway electrification are already afoot. These examples are merely representative of the remarkable recent shift towards the use of electricity in larger and ever increasing quantities and in more diversified fields.

There are many good and cheap hydro projects each of which can produce more than a third of a million kW. These are either in the preliminary stages or still to be taken up. Some of these are:

1. Sileru	(Andhra)
2. Inchampalle	(Andhra)
3. Srisailam	(Andhra)
4. Kopili	(Assam)
5. Keli	(Bombay)
6. Pambiar	(Kerala)
7. Iddiki	(Kerala)
8. Punasa	(Madhya Pradesh)
9. Burwaha	(Madhya Pradesh)
10. Harinphal	(Madhya Pradesh)
11. Hurma	(Madhya Pradesh)
12. Sharavathi	(Mysore]
13. Kalinadi	(Mysore)
14. Bhimkund	(Orissa)
15. Tikkerpara	(Orissa)
16. Beas-Sutlej link	(Punjab)

There is one prerequisite. however. before the development of electric power on an extensive scale can be taken up. At the present time, we have to depend for most of the equipment required for production, transmission and utilization of power on other countries. This is a great drain on the country's foreign exchange resources and would therefore limit the development. As thermal schemes require more foreign exchange than hydro schemes, it will be advisable to limit the thermal stations to favourable locations such as mineheads, etc. Also. measures must be taken to start manufacture of turbines and generators and increase the manufacture of transformers. switchgear. etc. The heavy electrical plant factory at Bhopal is limited in the first stage to the manufacture of transformers and switchgear. By augmenting the plant at Bhopal as stated already and encouraging the indigenous manufacture of electrical equipment by providing capital and other facilities. we must reduce our dependence on foreign countries so that power development can take place at an accelerated rate.

With further developments in the field of nuclear power generation, it may be that coal and oil fuel thermal power may not ultimately prove competitive with it, but it is certain that there will be always a demand for hydro power, which has unique advantages for peak load purposes and will serve to aid the base load from nuclear stations.

Flood control of rivers

Floods were known from ancient times in India but did not prove destructive because the people did not occupy the flood plains due to the scanty population of those times. Even so, in Bihar and Uttar Pradesh, we have references in Buddhist literature to villages being constructed on man-made islands. It was only in 1954 that a national scheme of flood control was enunciated. As there was little data pertaining to many of our rivers, a large amount of investigation work was organized. Nearly 47,000 sq. miles of aerial photography was done and also 38.000 sq. miles of spot levelling. Many miles of embankments were constructed and thousands of marooned villages were raised. In Assam, the protection of Dibrugarh town by spurs has been one of the most successful protection works. In Orissa, a major success was achieved at Dalai Ghai by spur protection. The work done so far represents a bold attempt at control of some of the rivers. But this is not sufficient. We have yet to cover an extensive field.

Recent advances

Like in all other fields of science, engineering has made in very recent times and is continuing to make every day spectacular advance. Research, design and construction practices in every field of engineering have undergone at least as much refinement in the last two decades as they did during the previous two centuries. The evolution of prestressed concrete, framed structures, membrane or skin structures, advances in grouting methods and practices, would all be breathtaking to the 'frog-in-the-well' type of engineer. It should be remembered such advances have come to pass only as a result of intensive thinking and research work on the part of thousands of farsighted engineers and technicians in a competitive international effort.

In the field of research, advance has been the most spectacular. Actual observations of the in-place shear and bearing strengths of rocky and soft foundations, use of bakelite or plexiglass models for determination of stresses in locations not easily computed by analytical methods, use of tenso-net or stereometric patterns, use of electronics for simplifying involved computations, and the harnessing of radioactive isotopes for studies on seepage under dams—both in models and prototypes—, employment of gamma-ray scattering for the determination of the sediment density in reservoirs, are some instances of such advance.

Design practices have registered significant advances particularly in respect of dams and similar rivet taming works. Dams with power plants located in their bodies or underground power houses have come into vogue. Laboratory as well as analytical studies of stress conditions in dams with 'incorporated' power plants stress the limitations of two-dimensional analysis only. Three-dimensional analysis has revealed that the presence of draft tubes weakens the downstream face of the profile proportionately more than the penstock does to the upstream face. In order to reduce the weakening of the dam resulting from the draft tubes, modern design practice specifies better concrete with higher modulus of elasticity for such locations, resulting in zonal variations in the quality of construction materials. An instance of zoning of material is available in the case of Nagarjunasagar Dam in this country.

Another example of new innovations developed to meet site conditions is afforded by the Glen Canyon Dam on the Colorado River in the U.S.A. The foundation rock and the canyon walls consisted of sandstone, some portions showing weak strengths of 120 to 180 tons per sq. ft. and with a low modulus of elasticity of 0.6 million lb. per sq. in. Also. the rock showed a permanent set on first loading. The designs were made to suit the properties of the rock. By flattening the section at the abutments, stress on the canyon walls is reduced to 400 lb. per sq. in. instead of the usual 1,000 lb. per sq. in. Also, at the two end joints, on either abutment, space is left so that by means of hydraulic pressure the initial set of abutment is obtained, after which grouting of the joint is done. To achieve economy, Glen Canyon Dam is designed as an arch dam, and it is therefore essential that the upstream and downstream faces have to be durable. The aggregate available in the vicinity of the dam is composed of stones of which the specific gravities are both below and above 2.5. Laboratory tests showed that concrete with aggregates of less than 2.5 specific gravity is not durable. Therefore, it became necessary to separate on a commercial scale the mixed aggregate. The aggregates are being sorted out by the heavy media method. The combined aggregates are placed in a solution of magnetite (sp, gr. 5) and ferrisilicate (sp, gr. 6) mixed in proportions of 40:60 to which water is added to obtain a solution of about 2.5 sp. gr., and the material lighter than 2.5 sp. gr. floats and is separated.

The design of recent earth dams has been spectacular as, for instance, the 512 ft. high Swift Dam and the 540 ft. high Trinity Dam, both in the United States. Rainfall occurs at the Swift Dam site throughout the year and is of the order of 120 in. A high earth dam had to be constructed in wet conditions. Test embankments were constructed simulating with sprinklers a rainfall of 2 in. an hour. Based on extensive tests, a material having 15% silt is being placed there at the rate of 20,000 c.yd, a day even in the month of December with a rainfall of 25 in. The precautions specified here are that the borrowing of soil must be from a vertical face, rolling must be done at right angles to the axis of the dam in order to facilitate drainage, and the time lag between placement and compaction must be minimized. Another interesting feature in this dam is the interpolation of a nearly vertical filter, designed to ensure avoidance of saturation of the downstream portion of the fill because of the similarity of the materials both in the shell and in the core. In the case of the Trinity Dam, a soil with 45% rock (maximum size limited to 5 in.) is used in the core.

Such bold designs have become possible only as a result of improved construction techniques. A simple process as clay injection has been developed almost as a fine art by French engineers. The construction of the Sere Poncon Dam on the River Durance is an interesting example. The dam is 400 ft. high and is located on a permeable bed 330 ft. deep. Any positive cutoff wall being out of question, clay injection was the answer. The construction proposals for the High Aswan Dam in Egypt illustrate the daring advances that are now entering the realms of 'practicability'. The dam will be of rock-fill with clay core. The 600 ft. thick bed underneath the 260 ft. high dam is sand and gravel. The difficulty is in having to construct the dam, which will be upstream of the existing dam in a pool of water of 30 ft. minimum depth. It is therefore proposed to place sand up to the water level and then have the impervious blanket. The consolidation of the sand will be done with heavy vibrators of 1,500 lb. weight each. These measures were deduced after field experiments.

The few selected instances serve to emphasize' that advances in engineering have to be based on new thinking, scientific and daring.

5. Engineers and national leadership

In the comity of the nations of the world, India today is an underdeveloped country. The India of today is not a country of abounding prosperity which our ancestors handed over. Everywhere we see an India in Need; not an India of Prosperity, which we must build for our succeeding generations by our unflinching determination and incessant efforts. Success can be achieved only by a united group and never by individuals. Just as the Indian National Congress won the political freedom for the country, our Institution, along with other institutes of scientists, should be the spearhead for achieving economic and technological independence of the country. For this, the Institution has to be strengthened by engineers joining in larger numbers than at present. Our Corporate Membership is under seven thousand, whereas that of the three premier U.K. Institutions (Civil, Mechanical and Electrical) is more than sixty thousand. A serious effort is being made in the U.K. to reunite the various Institutions into which the Institution of Civil Engineers was earlier splintered. It is only by having a single Institution as ours in which all the branches of engineering are catered for amply in their particular spheres with an appropriate amount of autonomy. but always within the framework of the Institution. that the most authoritative and logical engineering society can be built up. I understand that the Central Government are taking steps to obtain Parliamentary sanction for incorporation of a National Institution of Engineers as an institution of national importance. As the Institution of Engineers (India) is open to and consists of engineers of all branches and has been doing pioneering and outstanding service for the last thirty-eight years. I hope that this Institution will receive that honour.

Our technical publications must be improved and strengthened by contributions on current engineering development and research. The Central Government can help the Institution to obtain technical papers of high quality. if they institute awards for the best papers in subjects of special significance published in the Journal of the Institution. similar to the awards made by the Railway Board.

Engineers are resourceful, hardworking, persistent, and greatly devoted to work. They possess many other good qualities but as a rule they cannot express themselves well and therefore remain in the background. But, as the future of India depends on their wholehearted participation, it is necessary for them to come out of their shell and assume a leading role in the shaping and implementing of the national policy of development. The Government have recognized this. It is necessary to remember that leadership is never conferred but earned. Engineers have to participate in the State and Central Legislatures. the Planning Commission, and as Ministers of Government. Then only will the engineering profession be energized and a scientific and technological climate prevail in the country, which is necessary for moulding the shape of the future India of peace. plenty and prosperity.

Jai Hind.

Presidential Address

(1959-60)

'I am deeply grateful for the honour you have conferred on me by re-electing me as the President of this great body of engineers in India. I hope we shall achieve, through our combined efforts, an enhanced status for our profession and our Institution.

My first task as President is a most pleasant one. On behalf of the Institution, I have great pleasure in welcoming our Honorary Member, Shri Jawaharlal Nehru, Prime Minister of India, and all the other distinguished guests gathered here today anthe occasion of the Fortieth Session of the Institution of Engineers (India).

2. Growth of the Institution since 1920

The Institution of Engineers has come a long way since its inception in 1920. The membership, including Students, has risen from 138 to over 25,500 today. The Institution is a unified one and caters for engineers of all categories. The Institution has sixteen Local Centres and three Sub-Centres spread all over the country. At all these centres, technical discussions on various engineering problems are held every month, generally on the first Wednesday of each month. To popularize the engineering profession and encourage engineering education, the Institution is organizing various measures. One of these is the recently established Public Charitable Trust for the Advancement of Engineering Education, under which five scholarships have been awarded for the current session. We are thankful to the public and the engineering fraternity for the generous response to our appeal for funds. A President's Rupee Scholarship Fund has been started to which each member of the Institution is requested to contribute one rupee each year. This in itself will make it possible for several scholarships to be established in the course of a few years. The Institution by holding examinations offers opportunities for any hard working apprentice to obtain a qualification which is equivalent to a degree in engineering. The Council has directed recently that the Institution should organize popular lectures to the workers on the various projects, and in accordance with this, the Andhra Pradesh Centre held the first meeting at Nagarjunasagar Dam site on the River Krishna which was attended by sands of workmen. Slides were shown depicting how the River Krishna begins with a trickle from the mouth of a cow carved out of stone at Mahabaleshwar and swells to a mighty river when it pours into the sea. Project views were also shown and various phases of the work explained. The workers showed keen interest and were so greatly exhaused that they declared they would speedily complete the work. It is hoped that similar meetings will be organized at project sites by all our Local Centres.

Last year I had the honour of reviewing the progress in engineering in India in several branches. This year I shall deal with the engineer's participation in the development of the country.

3. The challenging problem for Indian engineers

Engineers all over the world have problems to face and solve, but Indian engineers have more complex and difficult problems than many of their compatriots in other countries. We are fifty years late in making a start in undertaking the development of the country. Things were cheap and many more favourable conditions prevailed in the years gone by. Now the difficulties have mounted up, and the problem is as difficult as crossing a river in flood. We have to ponder and seek inspiration from the development of other countries. I shall first deal with the engineering development in the U.S.A. in the agricultural and industrial sectors, the twin seeds of economic prosperity of nations. Food grown each year in India for 400 million people is about 74 million tons, while for 168 million people, the U.S.A. produces nearly 185 million tons of food. Similarly, steel production in the U.S.A. is 115 million tons a year against 5 million tons in India, and our total output of 13 billion kWh of electricity is insignificant in comparison with the 600 billion kWh of the U.S.A. Even in respect of piped water supplies for drinking — an index of health — 25,000 million tons of water is delivered in a year in the U.S.A. as against 1,600 million tons for all our teeming population in the towns. These serve to show that we have a great leeway to make up.

All the great advances in the U.S.A. have been made from the beginning of this century. For example, storage capacity of waters in reservoirs, which is an approximate index to the harnessing of natural streams for production of power and food, grew in the U.S.A. from 4.5 million acre-ft. in 1900 to 600 million acre-ft. today. This was the result of the awakening created by Theodore Roosevelt who said, 'The rivers of no other civilized country are so poorly developed, so little used, play so small a part in the industrial life of the nation as those of ours'. He established the Bureau of Reclamation in 1902 and an era of conservation of water started.

It was possible to construct these great storages because of the advances made in the designs and construction techniques of dams, both earth and concrete. Through earth dams of small height were being constructed for several centuries, it was only after 1925 that, as a result of developments in soil mechanics, high earth structures started rising, as at Trinity Dam in the U.S.A. (540 ft.), utilizing local materials which, even a few years ago, were being rejected as unfit for earth dams. Similarly, many advances and new techniques, chiefly reduction of uplift pressures by grouting, foundation galleries, etc., have enabled construction of mighty concrete dams. It is interesting to note that the New York Board of Water Supply rejected the idea of constructing an earth dam 70 ft. high in 1901, and now in the same country a dam of 540 ft. is in progress. The New Croton Dam constructed in the U.S.A. towards the end of the last century was inferior both in design and construction to the Periyar Dam built about the same time in India. The tremendous achievements in the construction of dams in the U.S.A. are not accidental but a result of intensive research and inventive effort.

In India, we had only 10 million acre-ft. of water stored up before 1947out of the available total of 1,350 million acre-ft., which is about the same as in the U.S.A. With our undertakings of the First and Second Plans, we will be pushing the storage to 100 million acre-ft. Conservation of water confers perpetual benefits, unlike the exploitation of minerals, etc., and is like a revenue resource recurring annually.

Similarly, steel production in the U.S.A. has increased from 10 million tons 1900 to its present figures. In respect of power, the rate of development is still more astounding — in 1900 the U.S.A. produced 2.5 billion kWh and it is now 240 time more.

The United Kingdom could step up its production and export of electrical machinery from Rs. 33 crores in 1938 to Rs. 400 crores in 1958, its actual production being Rs. 1,730 crores annually. Sweden had produced little electrical power till 1905 (about half a billion kWh) but now it produces 30 billion kWh, more than twice our figures, for only 7.5 million people. It manufactures its own electrical machinery, and construction procedures are developed so well that the cost of power schemes is as low as one-third of similar schemes in India. The great industrial build-up in Germany, in the short space of ten years, from bombed-out factories, is another example of the possibilities for quick progress.

Achievements in Russia show what engineers at work can do. With hardly half a billion kWh of power production at the end of the First World War, today, Russia is producing 250 billion kWh annually. This tremendous energy is in turn multiplying industrial prosperity. The Volga, loved by Russians as we do the Ganga, was serving no purpose other than navigation. But now its waters turn the wheels of power, producing millions of kilowatts. Siberia, which used to be called Nature's coffin, is now being turned into a Nature's nursery. Lake Baikal in Siberia has become the richest treasure house of power, and its waters, controlled and let down at will, are being harnessed at Bratsk Dam, to produce 4 million kW at one single station. Giant electrical generating units of 500,000 kW are being manufactured. We are just starting the manufacture of a 50 kW generator.

Japan, hit hard in the last war, has built a mighty industrial potential in less than a decade. She is able to export many industrial products. Turbines for 100,000 kW generators at Bhakra are being supplied by Japan. Whether we turn East or West, we see that nations have achieved tremendous progress through technology. Riches of a country are no longer determined by the bounty of nature, but by the efforts and ingenuity of its citizens. Now the best fed nations are those where the greatest technological progress has been made.

4. Building a technological climate

A proper technological climate has to be established in the country as a preliminary to the sustained assault on economic backwardness. I shall now discuss a few basic factors bearing on the subject.

First, I shall review the growth of engineering education — the gateway to the profession — in the U.K., after which our technical colleges have been modelled. Till the close of the last century, little attention was paid to engineering theory in the U.K. The young engineer had to pick up knowledge as a pupil in an engineer's office and most of the works were designed based on empirical rules. Engineering was considered as a 'base mechanic art' and there was opposition to teaching the subject at a university. Certificates used to be given and it was only 1903 that the London University began to award degrees in engineering. The First World War gave a significant fillip to engineering education; after the Second World War, added emphasis came on research and post-graduate courses. There is a further swing towards specialization, and the present engineering syllabuses are vitally different from what they were some years ago. Germany has always believed in the polytechnic system of education, and German industry employs graduates from polytechnics, although they have no actual works or office experience. 'Experience teaches slowly and at the cost of mistakes.' Research and specialization have always been greatly encouraged in Germany, the advantages of which are being widely recognized. Industry reaps where research sows.

In countries like the U.S.S.R., where rapid advances are being achieved, intensive specialization is adopted.

The education and employment of engineers in India have likewise to be reorganized so as to meet our new requirements. There is still a general feeling that a civil engineer should know every type of construction, buildings, roads, dams, etc. This was correct when the engineering works were of a simple nature, very few in number, and could be done slowly, and it was economical to employ the same person on all types of work. Now it is no longer the case. As new techniques and new developments take place in every field, engineers with special training are required. The important phase to a project, designing and development, has practically not been developed in India, so that most of our important designs in the past had to come from foreign engineers. This is still true in a large measure. It is most essential that early steps should be taken to ensure that competent design organizations are built up in the country. In the U.S.S.R., where every work is done by the Government, there are two branches in every engineering undertaking. For hydro power house construction, for instance, there are two departments. one for designs only and the other for construction. Future progress in Indian engineering depends on fostering specialist organizations. In the medical profession, we are accustomed to specialists, but in the engineering profession in India, no such specialization has so far been encouraged. In Government departments concerned with engineering for each type of work, there should be distinct design and construction branches. Engineers should be divided into two broad categories, (a) designing engineers, and (b) construction engineers, and they should specialize in their respective lines. Then only can they acquire efficiency and contribute to the advancement of engineering. Similarly, self-employed or consulting engineering organizations should be encouraged to be formed in every branch of the profession and specially in the branches for which corresponding Government design offices do not exist.

There must be a close liaison between engineering colleges and the profession of engineering. Professors must become leaders in their particular branches of engineering through research and active participation in the profession. They should be consultants. Then only can we assure ourselves of rapid progress in engineering. In Europe, the U.S.A. and all advanced countries, the professors at the universities are invariably recognized as high authorities in their respective fields. In India, as an interim measure, academic professors and working engineers in industry should be exchanged, at least for short periods, conferring mutual benefits, according to a definite programme. While this has been the aim, so far no substantial progress has been made. The only way to achieve this is to issue a directive that every top engineer in designs or construction should take up the tutorial side for a period of at least two years. A central institute may be established where the professors are given aid in their work and where the necessary industrial training is arranged with different industries.

Research is most essential for our modern economic life. It is really an intellectual adventure. Though our Government is encouraging research by award of scholarships and grants, it should be acknowledged that engineers have not been attracted. This is partly linked up with problems of employment and prospects. There are number of engineering research laboratories in the country, and if on the basis of the work done in these laboratories, university degrees are conferred, there will be a great impetus to the progress of research. Similarly, for engineers engaged in the practical side of the profession, ‘evening hours' may be permitted for research at the universities. These measures will enable the engineering profession in general to think of research, and in the course of time to become research minded. Also, it is necessary that for some years, engineers with post-graduate degrees should be given preference and higher salaries.

One of the important aids to the growth of the engineering profession is a good technical library with translation facilities. We have practically none. This handicap must be immediately removed. No engineering knowledge can grow in a vacuum. At all the Local Centres of the Institution we have libraries, but these are not well equipped for want of finance. It must be the effort of all, the Government and the public alike, to establish fully equipped technical libraries in all important towns. I am glad to announce that the Prime Minister of Jammu and Kashmir has kindly sanctioned a sum of Rs. 50,000 for the purchase of books for the library of the Jammu and Kashmir Centre. I hope similar assistance will be forthcoming from the other States for building our libraries in the respective Centres. It is also necessary for the members, at least the senior members, to donate one book each year to the Local Centre libraries.

It is to be admitted that the majority of engineers in Government service rarely keep up the habit of reading technical journals and new books. This is true bf senior engineers as well. The main reason adduced is want of time. The current financial outlook tries to reduce the staff all the time on the basis of work load. Nowhere is allowance made for study by the officer, with the result that Government engineers rarely have the opportunity to read any technical literature. Shortage of time affects in another direction. Very little thinking or meditation is possible. Thus both reading and thinking have become casualties. Unless one ponders what he reads, nothing is gained, as no good is served by eating food without digestion. A thinking man is a living laboratory. Thinking leads to inventive engineering, which is most needed in our country.

Engineering books are costly, and to make them easily available, prices have to be reduced. It is also to be acknowledged that when engineering books are translated into Hindi and other Indian languages and are properly assimilated, clear concepts of engineering will emerge. Ideas will be no longer hazy, and there will be no necessity for mere learning by rote. Our Institution is making some efforts in this direction by publishing a section in our Journal in Hindi. It may be noted that in the U.K., technical books were all in French till the middle of the last century. It was

Rankine who, by translating and writing books in English, made engineering knowledge easily available, and thereafter engineering began to take hold of the people and became indigenous to the land.

For some years. we must encourage publication of articles by engineers, even if they are not of a very high standard. It is only then that people will be freed of shyness, and we can draw out a book out of each engineer.

Conventions have to be developed, by which deserving young engineers, at whatever level they be, are encouraged to contribute freely their suggestions and are duly recognized by award of prizes or salary rise. In this connection I recommend to the Council that, as a contribution of ideas is more important than even contribution of subscriptions, we may exempt members who contribute original ideas from the payment of subscriptions.

It is necessary to publicize the engineering profession widely as a career. Liberal aid should be extended for prosecuting engineering studies to attract the best brain in the country.

Likewise, it is necessary at our present stage of engineering development, to entrust the management of engineering enterprise to members of the profession. This will ensure speedy decisions based on mature engineering experience and avoidance of unnecessary explanations and correspondence. For example, in the United Kingdom, engineering enterprises were largely in the hands of engineers until years. When a country has become prosperous and engineering works are established, the management may consist of both engineers and non-engineers. Indian engineers, railway engineers in particular, when employed on engineering undetakings, have shown remarkable success.

The suggestions indicated are intended to create a technological atmosphere in India. But they need finance. Money can be raised for the purpose, as was in the U.K. many years ago, by a special technical advancement tax. This can be repealed later, when the country attains a sufficiently high technical competence.

5. Need for speed and economy

Engineering is a ceaseless effort to extract benefits out of nature and its products. There will be successes as well as a few failures. Engineers must be stout of heart to put up with the latter. The year 1959 was indeed a bad year for structural engineers, specially in the sphere of dam construction. The year started with a total failure of Vega de Tera Dam in Spain in January, and ended with the failure of Malpasset Dam in France in December, both attendant with great loss of lives. Failures may humble a few, and mellow some others, but to the engineering profession they are of great value, as they give a glimpse of behaviour of structures with less than unity factor of safety. In the past, there were quite a few failures of dams, both earth and masonry, but these are becoming rarer with the replacement of rule-of-thumb methods by scientific engineering.

In India too, we experienced a few mishaps in 1959. The foundation shortcomings at the Durgapur steel plant and the loss of control in the hoist chamber of the Bhakra division tunnel belong to this category. When we laid siege to the River Sutlej and began to occupy its domain the river lost its temper and made a side attack. This posed difficult problems never met with before by engineers engaged in the construction of dams. It is gratifying to note that success has been achieved to regain control of the hoist chamber entirely by Indian engineers, civil and military, a band of disciplined engineers whom we are greatly proud of. Indeed, the way to Heaven is not strewn with roses, and every engineering endeavour and success implies conquest over difficulties and mishaps. Our undertakings in the last ten years have been huge and unprecedented in the history of our land. Some of our notable engineering achievements during 1959 are the completion of the Panchet Hill Dam in the Damodar valley and the Kotah Barrage in Rajasthan, the commissioning of the Rourkela, Bhilai and Durgapur steel plants, and the completion of the Mokameh Ghat bridge across the Ganga.

One of the essential things required to achieve greater success than at present is to speed up construction of our engineering works. In every other part of the world, machines and men are working round the clock, feverishly, on building up additions to their already full cupboards. In the U.S.A.. though food grains are produced far in excess of their requirements. even now irrigation projects are being built. In U.S.S.R.. I was told that in some parts. though irrigation projects are completed and water is available for utilization, people do not take water at present because it needs more manpower to reap the heavier yields from irrigated land. All the same, speed is imported into every one of their activities. Speed shakes off laxity, raises efficiency, and reduces costs. Programmes of construction can be adjusted to suit financial limitations. Thus, a time-table for works may be drawn up, so that there may be an interval between completion of a work and starting of another, if financial conditions necessitate. Once works are undertaken. they should be completed with the utmost speed.

An example where speed is very badly needed is in respect of manufacture of eletrical machinery. This is an aspect of vital importance, which cannot be overstressed and which would constitute a bottleneck to future plans, if it is not handled with vision today. No country can support a large programme of electrification on the basis of heavy imports of these costly equipments. The fact that much smaller countries as Yugoslavia, Switzerland, Hungary, etc. less endowed with the necessary mineral and other resources, have not only made themselves self-sufficient in this field but have also equipped themselves for export of these equipments clearly indicates that there are no insuperable problems. Achievement of self-sufficiency in this respect is an essential prerequisite for the large programmes for expansion of power and industries and for avoiding uneconomic costs of industrial products.

There is another important aspect of our projects that I would like to mention. Costs have gone up, making it difficult to undertake many other important projects. These trends have to be counteracted through savings by careful and economic designs. New methods of design and fabrication have to be employed. Great economies can result by exploiting in an appropriate manner new techniques, such as, welding, prestressing, use of light materials like aluminium, precasting, plastics, load factor theories in design, and use of electronics and nuclear energy. The great economies that are possible can be illustrated by a simple example. The determination of moisture in soil placed in an earthen embankment is done in India by obtaining samples, drying, and determining the water lost. This involves lot of labour and consumes time. In Sweden, by the use of isotopes, the determination of moisture has been achieved in a few seconds and at very little expense.

Again, out of a total cost of Rs. 1,250 crores earmarked in the First and Second Plan irrigation and multipurpose projects, Rs. 550 crores are being spent on dams and the rest on canals. Reduction in canal costs has to be aimed at by using new techniques. We should exploit fully the precast technique, which is being tried as an experiment even in the construction of dams in the U.S.S.R. Cross-masonry works, bridges, etc. should be amenable to precast systems. It is stated that in the U.K., between 1920 and 1937, the increased demands of power were met almost entirely by increased efficiency of energy conversion and utilization. Forty-seven million tons of coal was saved.

Similarly, in every field of engineering, we must be on the alert to use recent technological advances. This calls for mastery over the new techniques. There are some very important fields, such as instrumentation, computation and automation, in which we have as yet very little knowledge in this country. The value of these cannot be overemphasized. For example, digital computers are used to solve very intricate and involved differential equations. It can solve shell design problems in 25 seconds instead of as many hours by the usual methods. Complete coordinates required in calculations for the Glen Canyon arch dam in the U.S.A. were obtained in

40 hours as against an year employing a large force of engineers. The study of innovations is being suggested not for conservation of engineering personnel but for keeping our selves abreast of modern developments and knowledge.

We have to concert special measures to acquire the specialized knowledge. One way would be to institute special chairs and posts of readers in each of the subjects at selected universities and arrange for running special courses covering the latest advances. Also, the concerned departments must provide for specialist posts in the subjects, offering suitable salaries.

6. Conclusion

The progress of a country in modern times depends on the efficiency and talent of its engineers and scientists who have to work as a team. Even war is no longer confined to soldiers but is really a battle between laboratories. Techniques of peace are more difficult to be developed and always lag behind the techniques of war. Thus the Hiroshima bomb heralded the atomic age in advance of the techniques of peaceful utilization of atomic energy.

India is still behind times in science and in technology and has to tackle problems solved in other countries many years ago. She has to achieve a technical revolution. The situation calls for a reorientation of outlook and a method of working different from and more dynamic than what we are following at present.

The Institution of Engineers places itself at the disposal of the Government for consultation on engineering matters, objective evaluation of projects, and any other service in the development of our country, To quote an example from the United Kingdom, the British Government relies entirely on the Institution of Electrical Engineers for wiring rules and installation practices. The engineering profession is greatful to the Prime Minister for selecting one of their distinguished members and a Past-President of the Institution, Dr. A. N. Khosla, first as a member of the Rajya Sabha and now as a member of the Planning Commission. We hope that this is but beginning, and in the course of time many more engineers will be appointed to State assemblies, to Parliament, and to other policy making bodies, so that they may usefully contribute the engineering point of view on different problems arising out of the community effort to make life happier. As life is largely conditioned by engineering, the engineer's participation, with his habit of accurate thinking and , analysis, will be highly beneficial.

The Prime Minister of India has a fascinating way of stirring up the nation to great deeds. May I request you, Sir, to ignite in the engineers, the spark of inspiration initiative and courage so that they may put in their great effort in restoring our ancient country to shine again as a bright star in the firmament of nations of the world.

Jai Hind.

Dr K L Rao — a Brief Profile

Dr. Kanuru Lakshmana Rao, B.E., M.Sc.(Eng.), Ph.D., M.I.C.E., M.I.Struct.E., M.I.E., was born on July 15,1902.

After passing his Intermediate Examination in Science from the Madras University, he took the BE degree in Civil Engineering with Honours' from the College of Engineering, Guindy, in 1925.

His first appointment was as Assistant Engineer in the Vizagapatam District Board in 1926. He subsequently worked as Lecturer in the College of Engineering, Rangoon, and Guindy, and in the Cauvery-Mettur project. During this period he also qualified for the M.Sc.(Eng.) degree of the Madras University by research, being the first recipient of a research degree in engineering from that University. In 1951 he joined the Central Water and Power Commission at New Delhi as Director (Dams). In 1954, he became Chief Engineer, Planning & Designs, and is now Member (Designs and Research) in the same Commission.

In 1939,he proceeded to England to specialize in reinforced concrete, and obtained his Ph.D. degree from the Birmingham University where he worked as a Research Fellow. Between 1943 and 1945, he was employed as Senior Lecturer in Loughborough Engineering College, Leicestershire, being the first Indian to hold such an appointment in the United Kingdom.

On his return to India in 1946, he was appointed by the Madras Government as Design Engineer in the Ramapadasagar project. He visited the U.S.A. on three occasions to study American dam designs and construction. During these later years Dr. Rao has been closely associated with a number of major dam projects in this country, notably Lower Bhavani, Tungabhadra, Hirakud, Malampuzha, Kosi and Umtru, and, recently, with flood control on the Brahmaputra River at Dibrugarh. His personal contributions to these projects are acknowledged as outstanding.

Dr. Rao is the author of a well known standard work 'Calculation, Designs and Testing of Reinforced Concrete' published by Sir Isaac Pitman & Sons. His contributions to technical journals are numerous. He has the rare distinction of having twice won the premier prize of the Institution for the best paper during — a year — with his paper 'Engineering Problems in Ramapadasagar Dam Project' in 1947-48, when the Prize was called the Governor-General's Prize, and with his paper 'Engineering Difficulties in River Valley Projects' in 1952-53, then the Prize had been renamed as the President of India's Prize.

Besides having extensively travelled in Europe and the U.S.A., Dr. Rao also visited China in 1954 with Shri Kanwar Sain (M.) when the Government of India sent a two-man mission to study river valley project techniques in that country.

Dr. Rao joined the Institution as Member in 1947. He was a member of the Council in 1948-50, and a member of the Central India Centre Committee in 1954-55 and 1955-56. Upon his election as Chairman of the Civil Section, he received a most enthusiastic welcome from members in this Section on his installation to the Chair of the Section at Chandigarh in February this year. The Civil Section, always the most active amongst the four major Technical Sections, has a very distinguished civil engineer at its head.

Maj Gen Harkirat Singh
President 1960-61 & 1961-62

Presidential Address
(1960-61)

I. I am very grateful to the members of the Council of the Institution of Engineers who have bestowed on me a great honour by electing me as their President. I am conscious of the heavy responsibility that goes with this honour, and I pray that I may have the strength to justify the confidence that has been reposed in me.

You will forgive me if, at times, I feel a little overwhelmed and diffident. It is because in this Chair I am succeeding so distinguished and eminent an engineer as Dr. K. L. Rao. I cannot hope to match his talents but I can take solace in the thought that, after all, men like Dr. Rao are very rare.

2. As a soldier I am expected to talk something about military affairs. Throughout history military affairs have been intimately connected with the course of the development of society. The Industrial Revolution of the 19th century in Europe and the rapid progress of science and technology in the last seventy years have had great influence on military organization, tactics and strategy. It is being increasingly realized that the military strength of a nation is primarily dependent on its technical strength. In his book 'Science and Technology in Contemporary War', Gen. Pokrovsky of the Russian Army says :

> 'The development of military technology, of military industry, and, especially, of heavy industry, must be considered as inseparable links supporting the military potential of a country. Military technology is connected with the entire industry and economy of the country in a multitude of ways. The level of development of military technology depends

directly on the level of economic and technological development'.

3. Therefore, to a military engineer whose role it is to apply engineering knowledge and resources to the furtherance of military plans, a study of the economic and technical development is of paramount importance. In an emergency it will be necessary to mobilize the entire scientific and technical knowhow, and economic and industrial resources of the country for the furtherance of the national aims. The technical and production forces of a nation exert enormous influence on military affairs. I may here quote the words of a Past-President of this Institution, Lt.-Gen. Sir Harold Williams, who said in his Presidential Address in 1954 that

'Every engineer who by his technical knowledge and skill and his industry and determination contributes to the development of India's industrial potential is contributing directly to her defences'.

4. Let me, therefore, turn to the industrial growth of India. At the very commencement of our Five Year Plans, it was realized that industrial development could not take place without advancing the total economic growth of the country. The aim of all economic growth is to raise the standard of living of the masses. Now this standard is relative to the standard of living prevailing elsewhere in the world at a given time. It may be stated that as compared with the 19th century Europe we are a highly industrialized nation today. As Pandit Jawaharlal Nehru says, in our progress, we have to jump a few centuries. Our rapidly increasing population poses a further problem, as a rise in material output equal to meet the requirements of increased population has to be set aside before any improvement in the standard of living can be achieved. It is like trying to go upstairs against an escalator which is going down at a fast pace. To do so you have to run, and if the backward speed of the escalator is equal to your running speed, you have literally to run fast to stand still.

5. It is said that in spite of the efforts that we are putting in for our economic growth we are, in a sense, relative to the growth taking place in other parts of the world, hardly managing to stand still. Very recently, speaking at the Indian Science Congress, Prof. N. R. Dhar told us that the United Nations Statistical Department had declared that India was the most hungry country in the world. Being hungry, being poor, does not only make us weak in our defence of the country, but it corrodes and rots away the very foundations of our cultural life. In spite of all that is said about *sanyasis* and the virtue of minimizing our worldly needs, we believe that for the mass of the people poverty is degrading. We believe that cultural and spiritual life cannot coexist with poverty.

6. Our Government has declared war against poverty. In this war, like any other war, time is of the essence. It is now generally accepted by engineers, scientists, technologists, economists, military and political leaders, indeed by all whose business it is to plan for the future development of our nation, that if India is to remain one of the great nations of the world, she must gain a decisive victory over poverty during the next ten years, and to do so, she must reach the takeoff point of a self-generating economy in the next five or six years. The practical application of science through technology and engineering has given us the potential ability to achieve a high standard of material wellbeing. It is the will of our Government and our people that we do so. We have large material resources in the country, and the skill of our engineers and technicians is second to none in the world. Of course, we need some help from friendly countries in the way of machines to give us a start, but we know that that help is willingly given. Yet, to achieve this victory over poverty, we have to direct all our energies and make the maximum use of our available resources of men and materials.

7. This brings us at once to the problems of management, particularly the management of engineering activities, as it is the purpose of these activities to increase the standard of living of the people. A brief study of our Five Year Plans will show that nearly 70% of our activities require engineering appreciation, planning and execution. It is apparent, therefore, that the

success of our Plans depends largely on our engineers. They are our first-line troops. It is vital to ensure that they are capable and their morale is high. It is, therefore, vital that the management of engineering enterprises is of the highest order. I propose to speak this morning on the subject of management of engineering activities.

8. But before I go on to that subject, I wish to say that I have been using the terms science, technology and engineering although I know that there is some confusion in the minds of people about the meanings of these words. I admit that it is difficult to give precise definitions that could apply universally in all conditions but, for the purpose of clarity, I must explain the meaning that I am attributing to these words.

Science deals with the discovery and correlation of knowledge relative to the unchanging laws of nature.

Technology involves the application of knowledge derived from science to the use and service of man.

9. A scientist is concerned with absolute facts. He formulates laws of nature in such a way that variation due to human judgment is eliminated.

10. A technologist, on the other hand, is concerned with the application of scientific knowledge to the needs of man. In his work of design and development, he cannot ignore the human factor. Therefore, technology is inseparable from humanism. The technologist is up to his neck in human problems whether he likes it or not.

11. Engineering has been defined as 'the art of directing the resources of nature to the use and convenience of man.' In order to make the best use of the resources of nature, the engineer has to understand the laws of nature, i,e., science, and its applicability to human needs. i.e., technology. What is more, he has to so organize and direct the knowledge of science and technology and the resources of men, materials and machines as to achieve a pre planned and specified aim. In other words, an engineer is basically a manager.

12. It is also important for us to realize the relative impact of science and engineering in the economic growth of our country. Dr. M. S. Thacker in his Presidential Address to this Institution in 1956 said:

> 'We have too long concerned ourselves with science and its endless frontier. It is time we stripped science of its romanticism, put it to work, and produced results.'
>
> He went on to say :
>
> 'Development lies within the domain of the engineer and without it applied research becomes sterile. While basic work in clearly designated fields is necessary for the valuable stimulus it provides for technical research, actual application of such research for the evolution of a new process or product requires for the greater part the techniques of design and development.'
>
> 'The application of engineering research and development involves economic considerations often neglected in the deliberations of our scientist colleagues. Research applied to production must tackle four groups of problems, namely, industrial economics, production engineering, industrial psychology, and production management.'

13. This point was admirably expressed by His Royal Highness Prince Philip, Duke of Edinburgh, two years ago, when he was laying the foundation stone of the Delhi College of Engineering and Technology. He said:

> 'At the moment, the Indian Science Congress is attracting a great deal of attention. Every aspect of science is being discussed and my impression is that the people, here in India, are particularly interested in what science can do in a practical way. Can science, in fact, solve or, at

any rate help to solve, some of India's most urgent problems? The answer is that science by itself can only answer scientific problems and it can only establish facts. Something or somebody else is needed to turn scientific fact to practical advantage.

That is the real importance of the engineer, the technologist, and the expert administrator. Science demands integrity of thought and an acceptance of facts of nature. Engineering and technology demand ingenuity and a refusal to accept anything as impossible.

I would go so far as to say that in the short run, here in India, the engineer and technologist can do more for the material progress of India than the research scientist.

There is a wealth of knowledge available in the world ready and waiting to be put into practical use. The only people who can do that are engineers and technologists. '

14. I feel, however, that although one can differentiate between science, technology and engineering in a particular way, it is not possible to draw sharp dividing lines of definition applicable to the personnel involved. Many chemists and physicists are engaged in the application of scientific discoveries and many engineers get involved in fundamental research. I would, therefore, say that for the purpose of considering these personnel, the term 'scientific manpower' should be taken as a composite term including scientists, technologists and engineers.

15. Now I must turn to the subject of management. In a lecture given to a joint session of the Institutions of Civil, Electrical and Mechanical Engineers, London, Sir Ewart Smith dealt with the subject of 'Management and the Engineer'. Defining management as the organization and control of human activity directed to specific ends, he said:

'It would appear that the basic training and subsequent experience which are normal for the professional engineer should be pre-eminently suited to the development of good managerial qualities. Every engineering activity has a clear and immediate purpose, the achievement of which demands planning, decision and control. The engineer is brought up on the idea of change and progress. He has to carry responsibility for his work and results more directly than in almost any other profession; his mistakes are there for all to see, and he has either to correct them or to live with them-a most salutary fact. Engineering, too, always depends on cooperative action with other people. The engineer is exceptional also in having the opportunity to see management from the underside, and to gain experience of rank and file reactions during his period of practical training. Thus, the professional engineer should be well equipped to undertake wide managerial responsibilities. It is beyond question that he normally does so with success in his own field.'

16. Yet, in spite of these inherent advantages, we find that in India very few engineers are being utilized in the field of senior management either in the private or the public sector. In the last few years, I have met a large number of engineers from Trivandrum to Srinagar and from Amritsar to lmphal, According to their general opinion, leaving aside exceptions, our engineering and industrial activities are not working at more than 75% efficiency. Some consider even this figure to be optimistic. If, with proper management, we could make the effort of our material and human resources go 20 to 30% farther than it is now, we may have a better chance of going towards our goal of achieving higher economic growth without giving up fiscal respectability.

17. Industrial expansion is only one part of economic growth. The other part where engineers are closely concerned deals with the development of our water resources, transport facilities, including railways, roads, ports and civil aviation, building activities, generation and distribution of electric power, telecommunication, and so on. Expansion of these facilities is the essential prerequisite for any increased activity to carry out a planned programme aimed at betterment of the masses. These facilities are provided by State Public Works Departments,

Buildings and Roads Branch, Irrigation Branch, Electricity Branch, and Central services like the Railways, Posts and Telegraphs, Civil Aviation, and other similar departments. With the exception of the Railways, in all these departments, both at the Centre and the State level, Secretaries to Government are generally I.C.S. or I.A.S. officers. In many States, even the Chairmen of the State Electricity Boards are drawn from these services. In some places, even technical education and training is not in the hands of engineers.

Is this system working well ?

18. Let me quote to you from the address given by Shri C. L. Handa at the Annual General Meeting of the Punjab Centre of this Institution at Patiala in December 1959. He said:

> 'I must mention the rather acute sense of frustration that has overtaken almost the entire engineering profession engaged in the public sector from the north to the south and the east to the west in this sub-continent. I am referring to the situation that has been created between the technical and administrative services. Whereas there always has been room for both these wings ever since the dawn of modern economy, the subordination of the technician to the mere administrator in the higher rungs of service is an anomaly. The outmoded codes of office procedure which were devised by the British Rulers to serve the needs of a circumscribed system need to be interpreted with imagination and boldness so that they do not form stumbling blocks in the name of control or discipline. Our technical forces are the main weapons with which we are to fight against poverty and want. We must not blunt the edge of these very weapons. That surely will be the way to stagnation. Merely for the sake of old fashioned protocol, let us not impose any handicaps on our technical ranks. Let us not reduce them to a status where they cannot take day-to-day decisions on their own initiative. The direction of technical departments is best delegated to professional leadership both in the technical and administrative aspects, as they alone are competent to take final decisions. In a democratic set-up, they will be automatically responsible to Ministers, whose public position and general awareness will comprise sufficient safeguards for the public good. Routing the files on technical matters through a non-technical hierachy leads to endless duplication and delay without any commensurate gain.'

I make no apology in quoting him at length as he has expressed the general opinion of engineers so well. He further said:

> 'In the present procedures of Secretariat-ridden departments, the technical personnel have to sacrifice most of their time in educating their non-technical counterparts, with consequent adverse effect on the supervision and direction of field work. The engineers have an unenviable position in the present set-up because they are made responsible for the achievement of targets without being given the necessary authority. On the other hand, almost the entire authority vests in representatives of finance and administration whose responsibility lies mainly in the observance of set rules of codes and office procedures, no matter what the nature of the programme or emergency may be. This anomaly needs a radical change, and it is hoped that here will be some leaders with courage, who will force the change by tearing away from hidebound logic.'

19. Nearly three years before Shri Handa's address, Shri Kanwar Sain in his Presidential Address to this Institution at Trivandrum said:

> 'The technical men have a grouse that they are being progressively debarred from taking their share of responsibility at Government level and that nontechnical administrators have been introduced between the Ministers and heads ·of engineering departments. Even posts like general managers of nationalized factories, for which engineers would be best fitted in view of their practical experience and analytical approach to problems,· are being filled by non-technical administrators. The general experience is that this results in delays in the execution

of national schemes. The relationship between persons in the Secretariat and those in the technical service is becoming more and more remote.'

20. There must be an opposite side to the picture. This was examined in detail by Shri S. B. Joshi in his Presidential Address to this Institution at Hyderabad in 1955. After tracing the history and development of the Civil Services in India, ever since Macaulay laid down the principles of recruitment and promotion of the I.C.S. in 1834, he described the duties of a Secretary to a Government department and the relationship between the Minister and the Secretary. After giving the full case in favour of the I.C.S. and the I.A.S. as regards their claim to occupy the key position of Secretaries to technical departments, he said:

'It will be seen that the whole theory of the Administrative Service is based upon conditions which existed a hundred years ago. In those days, the State was more concerned in maintaining law and order. The State has now undertaken the functions of a welfare state which include the management of industries and other enterprises.'

21. Let us examine this further. There is no doubt that for maintaining an empire over alien people the British needed a system of administration which would ensure that nothing should happen in India without the approval of the White Hall. Hence their requirement to have a handful of top administrators to rule this country. On that basis, Macaulay's theory that if a person was good at one thing he could be considered as more or less omniscient was readily accepted and Civil Service officers were put in charge of all activities in India.

22. Macaulay's theory led to the concept of the pure administrator. Under this concept, a man does not have to be trained in the technical aspect of the enterprise or activity that he is managing or administering. It may have been workable in the 19th century but its efficacy in the latter half of the 20th century is, to say the least, extremely doubtful.

23. An imperialist power primarily interested in law and order has to have strong and centralized civil and police services. But we feel that a nation interested in economic growth and industrial development needs strong and centralized engineering, educational and medical services. The opportunities that a centralized service offers will give engineers that wide experience and broad outlook so essential in top management. Moreover, as our main rivers, our roads and communication, our power distribution systems, have to cross State boundaries, it is important that engineers who have to. deal with these matters should belong to an inter-State cadre and develop a national outlook as opposed to a State outlook.

24. The argument of relieving engineers of administrative duties because there is a shortage of engineers does not stand the test of arithmetic. For about 50,000 engineers in the country, the key posts that we are talking about number hardly one hundred or so. As against this, we are training about 6,000 engineers per year. As stated by Shri Handa, there is a collosal waste of time of the senior engineers under the present system. I have heard many Government Chief Engineers say that they could double their output if they took on the duties of Secretaries over and above their own duties. And, if there is a shortage of engineers, surely we should not thus waste their time.

25. Enginers have been accused that they want to give up the creative work for which they have been trained to take up the uninspiring work of Secretaries and pen-pushers. Do not get us wrong on this point. If engineers want to take on the Secretaries' duties, it is in addition to their own duties, because then' they would have the necessary authority commensurate with their responsibility. As the time and effort now consumed in secretarial discussions would then be saved, they could do more creative work for the economic and industrial growth of the country.

26. Another argument that has recently been advanced is that many of the States have a number of Chief Engineers and, therefore, it is necessary to have a non-technical Secretary to coordinate their work. Being non-technical, he would be impartial. It is also stated that as there are a

number of specialists in almost every department, no single engineer could be found who would know enough about all the technical subjects dealt with in that department, and hence an engineer-Secretary would be no better than an I.C.S. or an I.A.S. officer. One might as well say that as the musicians in an orchestra play so many different instruments and as the pianist cannot play the violin it would be just as well to have a layman conduct the orchestra. All I can say is that I might admire the courage of such a conductor who with the cooperation of the musicians might succeed for a while, but I would not expect any great musical achievements from him. I would prefer the conductor to be a musician.

27. I have a suggestion to make on the organizational aspect of the technical departments of State Governments. In view of the fact that all States have a number of Chief Engineers, I recommend that each State should have a wholetime Chairman of an Engineer Board, of which the various Chief Engineers should be members. In addition to the coordinating of the work of the various Chief Engineers and of other engineering and technical enterprises in the State, he should have the following directorates under his control:

(a) Personnel administration and training;

(b) Centralized planning;

(c) Works study;

(d) Research, development and standardization; and

(e) Engineer stores and plant.

28. I am convinced that such an organization will revitalize our engineering departments and give them a dynamism that modern engineering practice needs and which is essential for the development of our country. There is a Greek saying that 'Even gods do not fight against necessity'.

29. It is important to know how the great political leaders of our country, who rank amongst the great men of this century, view this problem of the engineer-manager or -administrator,

30. You, Mr. Vice-President, stated in your report of the University Education Commission in 1949 :

> ‘As civilization grows more and more complex and new discoveries in science and technology are being put to large scale use, great engineering adventures are being undertaken in every country, for example, the Tennessee Valley schemes and the Atomic Energy projects in the U.S.A., and the great hydroelectric and river development projects in different countries of the world, including our own. Earlier, we had the great railway and canal projects. The organization of large factories like the Tata Iron & Steel Co., falls in the same category. The ideal head of such an organization should be an executive who is also an engineer, scientist or technician and who has an intimate knowledge of the science and technique of the particular undertaking, both on the theoretical and practical side; and besides, has knowledge of finance and business administration and can handle large bodies of men. Such combinations are rare among professional engineers or scientists and therefore very often such posts were filled by lawyers, financiers, or even political leaders. Though some of these administrators have done their job well, there have been many failures or cases of gross mismanagement. It is preferable that engineers and scientists are put in charge of such jobs.'

31. At the inauguration of the Indian Science Congress at Poona in 1950, Pandit Jawaharlal Nehru said:

> 'Today, unexpected pressure has come to bear upon us in the economic and other spheres with the result that we have to think entirely in terms of a rigid economy. All these difficulties have come when we thought of a vast number of schemes to raise the standard of living.

We are dominated by a lawyer's mentality and more lately, by a classical scholar's. Latest in the picture is the businessman's mentality, The lawyer still plays a fairly important part in our politics. But neither the lawyer nor the classical scholar nor the businessman with his limited outlook can solve our problems. Only science can successfully be applied to solve the country's social and economic problems. I am more and more convinced that the tasks can only be done by scientists and engineers.'

32. Many other speeches and statements of Pandit Jawaharlal Nehru could be quoted. As far as we know, the Vice-President of India and the Prime Minister still hold the views that they expressed in the statements I have just given. But, as Mr. Dildar Husain has remarked in an article in the latest issue of our Journal, it is surprising that despite the Scientific Policy Resolution passed by the Lok Sabha and the stress repeatedly laid by the Prime Minister on the importance of engineers in the country, there has been no attempt at any objective assessment of the situation at any level.

33. It is said that bureaucracy and democracy are inseparable because of the Government's accountability to Parliament or other legislatures. Of course, a certain amount of bureaucracy has to exist in every form of Government. But we do not believe that a bureaucratic climate is an essential ingredient of democracy as is often made out. We believe that democracy is inherently more dynamic and progressive than imperialism or dictatorship. But democracy must overhaul its governmental machinery to enable men of action to act.

34. At various meetings of this Institution, which is the representative body of the profession of engineers in the country, in different parts of India, I find that, by and large, most of the conversation hinges on this one issue of management and administration of engineering and technical activities. I have quoted to you from the statements of some eminent engineers. I could quote from many other engineers, and you could quote from many more. I have done so deliberately as I wish to show that this is the burning topic of the day and has been so for the last decade, and all the important people, political leaders and engineers, closely concerned in this war against poverty, are talking about it. As Iqbal would say:

مرا رونا نہیں رونا ہے یہ سارے گلستاں کا
وہ گل ہوں میں، خزاں ہر گل کی ہے گویا خزاں میری

35. In the end, Ladies and Gentlemen, let me sum up the main points of my talk.

The military strength of a country is primarily dependent on its technical strength, and its industrial potential.

The economic growth of our country which is still the hungriest country in the world is of vital importance both for our defence and sustenance of our cultural life.

Economic growth can only be achieved by fighting a war against poverty and by making the maximum use of our resources of men and materials. To do so, we must have the highest standard of management and administration of engineering and industrial activities.

The engineers of India believe that at present as a nation we are not achieving all that we are capable of, and our productive efficiency is low.

We believe that the only way we can improve is to utilize the natural managerial ability of our engineers, and put them in the ranks of top management and administration of engineering and technical enterprises or departments.

This is a burning question of the day and a vital necessity, as our very survival as a great nation depends on our winning this war against poverty.

36. Finally, a word to my brother engineers. At this juncture of the history of our country, we stand at a crucial point. A great responsibility devolves on you to ensure the economic and industrial growth of our country in the next few years. We all know that you are facing great obstacles in your day-to-day work, the greatest obstacle being bureaucratic shackles. You have to be bold and break through these obstacles as you have an appointment with destiny and it coincides with the appointment of India with her destiny.

37. I will close with the words of Bacon:

> 'I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and ornament thereunto'.

38. Now, I request our honoured Chief Guest, Dr. Radhakrishnan, to kindly inaugurate this 41st Annual Convention of our Institution.'

** 'It is not my cry—it is the cry of the entire garden.*

I am that flower, that the autumn of every flower is as if it were my autumn.'

Presidential Address

(1961-62)

1. On behalf of the Institution of Engineers, I am very obliged to Dr. B. C. Roy for accepting our request to inaugurate this Convention. We know that most of the Ministers at present ate very busy with the forthcoming General Elections but the presence of our Chief Minister amongst us is a clear indication of the fact that he attaches due importance to meetings of engineers and the work that they do. For that, Sir, we are thankful to you.

2. I am very grateful to the Council of the Institution of Engineers for having re-elected me as 'their President for another year. It is indeed a great honour and I pray that God will give me the strength to discharge this heavy responsibility.

3. As you all know, the Institution of Engineers was founded in 1921 with a membership of 138. The formal inauguration of the Institution took place in Calcutta on 23rd February, 1921. The Institution was granted a Royal Charter in 1935 and it was the first Royal Charter given to a body which had its origin and functions in India. The objects and purposes for which the Institution was constituted included the promotion and advancement of the science, practice and business of engineering in all its branches. The activities of the Institution continued to expand rapidly over the country. We now have 18 Local Centres and a total membership of nearly 32,000. The outstanding feature of this Institution is that, true to its Charter, it represents all branches of engineering — civil, electrical, mechanical, telecommunication, chemical, mining and metallurgy. In 1960, the General Body approved an amendment to our Bye-laws recommending the formation of functional Divisions within the Institution representing various main disciplines of engineering and giving them all equal share in the administration of the Institution. We recognize that the profession of engineers as a whole benefits from the closest possible cooperation between the various branches of engineering. In the planning, execution and operation of any large engineer undertaking, engineers of all branches have to work together as one team. During the last few years, however, there has been a tendency to form new specialists' societies for subbranches of the engineering profession. In view of the successive Five Year Plans, it has been estimated that in about ten years time from now, the number of engineers in different branches will be 50,000 civil engineers, 47,000 mechanical engineers, 35,000 electrical engineers, 7,000 telecommunication engineers, 12,000 chemical engineers, and 8,000 mining and metallurgical engineers. In the best interests of the community and the advancement of the science and practice of engineering, it will be of immense value if all these engineers belong to one professional society.

4. To the engineers of India, the most topical subject of the day is the launching of the Third Five Year Plan which is to be the first stage of an intensive development programme leading to a self-reliant and self-generating economy. A study of the Plan indicates that almost three-quarters of the work required to be done under the Plan falls on the engineering profession. Straightforward engineering tasks like major and medium irrigation, power, transportation and communication, and industries comprise 62% of the Plan. In other fields like agriculture and community development and social services, there is a large amount of engineer work. Take, for example, agricultural production. This requires land reclamation, soil conservation, irrigation works both by canals and tubewells, production of modern agricultural plant and tools, and production of fertilizers. These are all tasks to be performed by engineers. It has been roughly estimated that building construction alone under the Third Plan amounts to nearly 20% of the Plan, i.e., nearly Rs. 2,000 crores.

5. It is one of the principal aims of the Third Plan to expand basic industries like steel, chemicals, fuel and power, and establish the machine building capacity, so that the requirements of further industrialization can be met within a period of ten years or so mainly from the country's own

resources. Development of these basic industries itself rests mainly on the basis of power, transportation and technical manpower. The success of any Plan aiming at economic expansion depends on these three vital items.

6. The programme for power development in the Third Plan is of the order of Rs. 1,089 crores. This is for a target of 12.7 million kW at the end of the Third Plan as against 5.7 million kW at the end of the Second Plan. This will give us a rate of power consumption of 95 kWh per head of population as against a mere 14 kWh in 1950. Although this rate of progress seems to be impressive, requirement of electric power rises so rapidly with expansion that it is anticipated that power shortage will continue for a long time to come unless the Plan is expanded in this particular respect. Incidentally, the development of power in Japan from 1947 to 1958 had resulted in an increase of power consumption per head of population from 455 to 930 kWh. Similarly, during the same period in Italy, the power consumption per head had risen from 454 to 922 kWh. I quote these figures to indicate that we have a big leeway to make up in this respect to meet our ever-increasing requirements for, industrial expansion.

7. Shortage of transportation has in the past caused serious bottlenecks in the progress of other activities in the Plan. Whereas railway development programmes go ahead as fast as practically possible, there is a strong feeling that road development programmes are very inadequate. The road programmes provide for the addition of about 25,000 miles of surfaced roads and also for improvement of the existing road systems, such as providing bridges and missing links and upgrading the existing roads. At the end of the Plan we will have 169,000 miles of surfaced roads. The quality of these roads is, however, so low that unless we spend huge sums on upgrading and widening and realignment i.e., almost rebuilding of a large number of roads now, we will not be able to carry the traffic that may be anticipated by 1965-66.

8. Requirements of technical manpower have been worked out. In engineering and technology, provision has been made in the Third Plan for expansion of facilities at the degree and diploma levels so as to increase the annual admissions from 3,860 for degree courses and from 25,570 for diploma courses to 19,140 and 37,390 respectively, In addition there is provision for the different types of part-time and correspondence courses and for the establishment of some specialized institutes. Expansion schemes for craftsmen training have also been planned.

9. It has been stated by some that, in a technological society like the one we-are aiming at, it is not only the producer that has to be scientifically trained but also the consumer to enable him to make the best use of the advantages that modern technology offers. Moreover, if technical education was wide-based, it would have the dual advantage of throwing up suitable men for higher technical education and of creating a better understanding and appreciation of the technical revolution that we are going through. The Union Minister for Scientific Research and Cultural Affairs has often stated that it is his aim to have a polytechnic in every district in India. Recently, the Chief Minister of a progressive State told me that in addition to a polytechnic and craftsmen school in every large and small town he wanted craftsmen schools in large sized villages as well which in itself would tend to revolutionize village economy.

10. I am sure that we are all in agreement with these sentiments. There is no doubt that the expansion of technical manpower is the most basic requirement for economic development. In the last resort, a country's greatest riches lie in the quality of her manpower.

11. I have had various discussions with the heads of engineering colleges and other senior engineers in the country on this subject. Whereas increase in engineering colleges and schools is essential, some express doubt as to the quality of the new engineering graduates or diploma holders. We find that, apart from a few institutions which have already got all-India reputation, the new colleges are not all keeping up to the required standard. This is a most dangerous state of affairs. Any doctor would appreciate the danger to human life if we were to turn out men with M.B.B.S. stamps who were not fully trained. Although badly trained engineers may not cause

damage to human life, they would definitely jeopardize our chances of industrial expansion and future prosperity. This question needs very serious consideration. The Institution of Engineers as a national body of engineers has the responsibility for recognizing various technical qualifications for exemption from Sections A and B of the Institution examinations. It is thus a body whose duty it is to set standards of technical education. We offer our services to the Central Board of Technical Education and the University Grants Commission to sort out this matter at the earliest.

12. A review of the progress made under the first two Plans during the past decade shows that although notable progress has been achieved in many fields, there have been some serious shortfalls in the industrial targets which the country set itself. These shortfalls have occurred in the industries which are of crucial importance. Such shortfalls have a chain reaction in the negative sense, as -they create a lack of balance in the development of resources and thus hinder general growth. I feel that although there may not be any cause for us to be unduly diffident, at the same time, we should not be complacent about our past achievements. Not only are the achievements below our own anticipation, but compared with other countries, our rate of progress has not been very great. The advances made in technology and engineering during the last fifteen years have been so great that various countries which were badly devastated as a result of the last war are now far more prosperous than they had ever been in their long history.

13. We are not really a backward country. We have rich resources and we have many skilled men. Except for the U.S.A. and the U.S.S.R., we have more educated people than any other country in the world. Although so far we were able to do reasonably well in spite of our outmoded methods, both administrative and technical, with the launching of the Third Plan aiming at the creation of a self-generating economy, a point has now been reached when we should carry out a detailed examination of our own shortcomings and create new organizational and technical patterns to achieve success. One may ask that when our past experience shows such gaps in expectation and achievement why do we embark on such a big Plan? The size of the Plan must be judged in comparison with our requirements, our resources and our technical skill, and the Plan should aim at a goal which would impel us towards the maximization of our national effort. Judged in this context, the Third Five Year Plan cannot be criticised for its boldness.

14. In the first place, it is very clear to me that the success or the failure of the Plan depends primarily on the community of engineers. I do not mean, Mr. Chief Minister, that your part in the success of the Plan will not be considerable but I do venture to suggest, Sir, that one of the major contributions that you and your colleagues can make to the Plan is in the backing that you give to your engineers who have to carry 75% of the load. As I feel confident of that backing, I want to put to my fellow engineers that if we fail it will be our fault.

15. What can the engineers do to ensure success of the Plan? The answer is that we must carry out all engineer tasks with the maximum economy and speed consistent with quality. This requires good planning, use of modern techniques, a sense of urgency, a sense of responsibility, of quality and integrity. Let me expand on them.

16. Every good engineer knows that no technical work should commence unless it is planned beforehand right down to its last detail of design, method of execution, its economics and its requirements in terms of men, material and machines, and its time factor. We know that time spent on thorough reconnaissance and investigation is never wasted. It should result in economy, saving in time required for completion of the work and higher quality of production. Yet how often do we see work commenced without full detailed plans? Sometimes, it is due to the fact that some V.I.P. wants to lay a foundation stone—at other times it may well be that some administrator or engineer wants to show off to gain a temporary advantage. But hurriedly starting a project or laying its foundation stone does not in itself help matters, because, after all, it is the time of completion of a project that matters.

17. Many of our construction methods and manufacturing techniques are quite outmoded. It is generally accepted that is the building industry, mechanization of construction techniques, standardization of components, and prefabrication would lead to large scale economies. Yet we are slow in adopting these methods. The difficulty is that standardization and prefabrication become paying only if most of the builders adopt than, and no formula has yet been found to make various building agencies follow a common method. In spite of the efforts of the Central Building Research Institute, the National Building Organization, and the Indian Standards Institution, it appears that conservatism in building techniques and practice is hard to eradicate. Every engineer employed in building work should, therefore, make a conscious effort to keep up-to-date in new techniques. I would very much like to see a Research and Development Section under every senior engineer executive, i.e., head of a technical department in Government or in a large industrial concern. That will ensure that some technical staff will keep on constantly studying and experimenting with new designs and techniques which will enable the department or the industry to take advantage of all the latest technological advances. Similarly, every technical or industrial organization should have a 'productivity cell' or a 'work study group' — the Planning Commission calls it a 'cost reduction unit.' There is no doubt that during the last decade work study has made great progress and introduced such economies that no modern technical organization can really afford to ignore its efficacy. There is also scope to exercise certain economies in the field of materials management. It is estimated that nearly 60% of the cost of any construction or manufacture goes into the purchase of materials required for it. Engineers would do well to pay greater attention to this aspect.

18. With the amount of work that has to be done in the next five years, it is imperative that engineers develop a sense of urgency. No one who watches the leisurely work going on for the construction of a road almost anywhere in India would think that we were engaged in a serious effort to build up our country or were fighting a war against poverty. Take the widening of any road-either a national highway or a municipal road. It seems the widening of a road gets sanction only when the incidence of traffic has increased to such an extent that the existing narrow road becomes hazardous. During the first year of the work, road metal is collected on the berms which further reduces road capacity. Next year, one-half of the road width is cut up for reconstruction plus widening, so that we are left with only half a roadway for our traffic. After that, the process is repeated on the other half. A little later, the first half which had been carrying very heavy traffic during the reconstruction of the second half requires repairs. So, for quite a considerable time, instead of getting a wider road, we get a narrower road. This picture can be seen in many parts of India.

19. With the use of modern construction plant, road work can certainly be carried out in a fraction of the time that it takes now. And to take the maximum advantage of the capital expenditure on construction plant, I see no reason why work should not go on for 16 to 24 hours in a day as it does in war. Working double shift will increase our tempo of work, our employment potential, and will create a sense of urgency and an awareness of the importance of the task we are engaged in.

20. In many fields of development, construction costs account for a substantial proportion of expenditure. In the public sector, most of this construction gets done under the control of Public Works Departments through the agency of contractors. Costs of construction have been rising due to rising costs of material, transport and labour. Although some reduction in cost can certainly be made by using improved designs, standardization, prefabrication, etc., it can be stated without any hesitation that considerable economy can also be introduced by changing our rules, regulations and procedures. Take the Government contract form itself. We all know that it is one-sided; almost all the burden is placed on the contractor who is to cover himself not only against the normal business hazards but also against the bottlenecks and harassment

imposed on him by the Government departments in the way of delayed decisions, delayed supply of controlled materials, delayed payments, and likely deductions from final bills due to technical examination of bills years after the bills have been paid. It is considered that about 10% saving can be effected if contracts are made more equitable and final payments are made promptly. This means a saving of nearly Rs. 200 crores in the Third Plan. I urge upon my brother engineers to pay more attention to these aspects and ensure that everything possible is done to avoid extra expenditure due to procedural difficulties. If the present rules and regulations are in the way, we must compel our Governments to change them.

21. Another point to which I wish to draw attention is the quality of our work: If our work is costly or slow, we can still have the satisfaction of having done something, but if at the end of it all the quality of our output in construction of manufacture is poor, we can only hang our heads in shame. Quality is the hallmark of all good technical work. We owe it to our profession not to accept anything which does not come up to the required standard. Let us, as engineers, endeavour to make the words 'Made in India' synonymous with guaranteed high quality. Every technical organization must have its own 'quality control' set-up and the men in this set-up should be imbued with the missionary spirit not to accept anything which is below par. I am sure your workers will appreciate such a control. The potential technical skill of our craftsmen and tradesmen is as high as anywhere else in the world. It is only a matter of technical direction and quality control to utilize this skill to the best advantage. One may say that with our progressive Five Year Plans we will meet the quantitative requirements of our country for its journey towards prosperity. But I sometimes fear that, if at this stage, we sacrifice the requirement of quality, it will be extremely difficult to catch up later. The temptation to sacrifice quality is there for an industrialist or a contractor to make quick profits or for Government concerns to gain popularity. We must guard against this.

22. I said earlier on, that the success of the Third Five Year Plan which will lay the foundations for the prosperity of this country depends on the engineers. Qualitatively, it depends on the integrity of the engineers. I refer here to the higher professional integrity, that is, to keep ourselves up-to-date with the latest technological advances in the particular discipline that we are employed in, to give our technical advice without fear or favour, to realize our duty towards society and not to degrade ourselves for financial advantage or by sycophancy to curry favour with our superiors. We must also realize that all engineering is teamwork in which a number of engineers from different disciplines of engineering and different organizations have to work together. In this context mutual recrimination, passing the blame for any failure from one to the other, or letting down the junior engineers is certainly unprofessional conduct. I do not mean that if there is a technical failure there should not be a thorough investigation into it. On the other hand, such an investigation is essential as we learn a great deal from failures; a good deal of scientific progress comes out of investigation of failures. But I do mean that any such inquiry should be with a view to find the truth and not merely for apportioning blame.

23. The Institution of Engineers, as a representative body of the engineers in the country, has an important role to play in this respect. As part of its Charter for the promotion of engineering science, practice and business, it is to strive continuously to create consciousness amongst its members of their duty to society, to their profession, and to one another. We are taking action to bring out a new Code of Ethics for members of the Institution and we shall take necessary steps to enforce this Code.

24. There are certain aspects of engineering tasks in the Third Plan which require Governmental reform. I say Governmental reform because it is in the very nature of the Plans and the pattern of society we are creating that all progressive reforms have to emanate from Governmental sources. The Government engineer both in a Government department and public industrial concern has heavy responsibilities, but by and large, he has not been given commensurate authority, liberty of action, and trust to enable him to fulfil those

responsibilities. Too many controls have been introduced in the name of accountability resulting in delays, inefficiency and frustration. There is a general mistrust of the engineers and when small things go wrong an inquiry tends to become an inquisition. The Planning Commission has dealt with this problem in their Third Plan and has made some' recommendations. We do hope that the Central and State Governments will take notice of these. The Planning Commission has also created a panel under the Committee on Plan Projects for examining public works administration. The report of this panel is expected to come out shortly and we hope it will be acted upon.

25. It was as a result of the growing consciousness of the role of engineers in building up the prosperity of this country that the Institution of Engineers organized a Symposium last November on the 'Economy and Efficiency of Engineering Enterprises in India'. The Symposium was attended by a large number of senior engineers from the technical departments of the Centre and the States, and public and private undertakings, universities, scientific and technical organizations, and research establishments. All branches of engineering were represented. The attendance was so much that it set a record for technical symposia in Delhi. As far as I know, never before in the history of India had so many top engineers of the country got together. The most important thing was that they were all unanimous in their general diagnosis of what was wrong with the administration of engineering enterprises which result in lower output and higher costs. It became very clear in the Symposium that there is an urgent requirement to reorganize Government technical departments and to reorientate our concept of management of industrial enterprises. The members felt that if this was not done the success of the Third Five Year Plan would be jeopardized. The Union Home Minister who inaugurated the Symposium declared that he would soon appoint a high level committee to go into the points that were brought out.

26. I will now present briefly the main issues that were brought out by this highly representative body of engineers at the Symposium. Under the term 'engineering enterprises' were included all large industrial undertakings of a technical nature like production of power, steel, industrial machinery, machine tools, fertilizers, etc. and also technical departments of the Government for the construction and maintenance of irrigation works, roads and buildings, and other similar organizations. It was found that management of the great engineering enterprises in the public sector had been vested with the administrative services. The engineer who has to carry the major burden to produce the results is often harassed by the administrator, auditor and accountant. This point needs no labouring and it is not only the engineer who knows it but all sections of the community are aware of this malaise, a handing down from a tradition which has long outlived itself. It was clearly demonstrated by a large number of examples that although the present bureaucratic pattern of administration may have been suitable for the maintenance of law and order it was not competent to deal with the requirement of a nation aiming at rapid economic development. It was considered that if the administrative pattern was not modified soon the technical men would find themselves, incapable of coping with the vastly increased tempo of work that the Third and subsequent Five Year Plans would impose on them. At this stage of development of our country, I submit that a point has been reached when administration must be reorientated to concepts of action as opposed to concepts of caution. I feel that the most important task that we have in front of us is to increase the productivity of every man, every machine, every ounce of fuel, and every acre of land, so that in the implementation of our great plans we get one hundred naye paise worth out of every rupee.

27. Many Government engineers at the Symposium pointed out that they had to spend a good deal of their time in dealing with a host of secretariat officials, financial advisers and auditors and as a result of it, senior engineers, whose task it was to direct and guide the activities of their large technical departments, were themselves reduced to file pushers. If the head of a technical department wants any improvements or introduction of modem techniques in his department,

it is not enough for him to just prepare a proper scheme. He has to have endless patience and cunning to steer his scheme through a large number of channels, called 'proper channels.' And he himself has very little authority to do anything except routine work. How then do we expect big tasks to be carried out, initiative to be used, and technical progress to accrue? Let me quote the Planning Commission:

> 'Lack of delegation within the enterprise is another common failure. Even as the general manager does not enjoy sufficient authority to manage effectively, there is often a failure by him and other management staff in the hierarchy to delegate authority to others down the line. who cannot do their jobs properly without the necessary authority. The lack of delegation of authority is usually accompanied by a failure to define responsibilities and duties. Nobody can operate confidently or effectively or be held responsible for results unless he knows what he is supposed to do and has the authority to do it.

That was stated by the Planning Commission.

28. Let us face the fact that after all the basic procedural pattern of Government administration has not changed much since the days 'Sardar Patel discovered that though he was Home Member he could not create so much as the post of a *chaprasi* without Liaqat Ali's concurrence.† This pattern is based on a network of rules and regulations developed some thirty years ago which were designed to ensure bondage for those who dared be progressive. Strong opinions were expressed by many of those who attended the Symposium that urgent action was necessary to revise all the old rules and regulations, redefine relative responsibilities of various types of officials in the Government, and delegate authority to those who have the responsibility for results.

Let me repeat it. *Urgent action is necessary to revise all the old rules and regulations, redefine relative responsibilities of various types of officials in the Government, and delegate authority to those who have the responsibility for results. As President of the Institution of Engineers, on behalf of the engineering profession in India, I am duty bound to urge the Governments to consider these suggestions.*

†*Maulana Abul Kalam Azad in 'India Wins Freedom', p. 193.*

29. In the end, Ladies and Gentlemen, let me say, that we are all convinced of the importance of the Third Plan. We congratulate the Planning Commission for this excellent task. As engineers, we are happy at the opportunity it will give us to serve our Motherland. We are conscious of our great responsibility, and with God's. will, we shall discharge it well. We know that our country is now on the threshold of great developments for which in time to come the sky will be the limit. We are at a stage when we can justifiably think, as Iqbal has said in 'Javab-i-Shikva', that

کوئی قابل ہو تو ہم شانِ کئی دیتے ہیں
ڈھونڈنے والوں کو دنیا بھی نئی دیتے ہیں

30. I now request Dr. B. C. Roy to kindly inaugurate this 42nd Annual Convention of our Institution.'

Dr T Sen

President 1962-63 & 1963-64

Presidential Address

(1962-63)

'I thank you all for electing me President of our Institution. This is a very high honour indeed. In fact the highest that can be bestowed on one belonging to our profession. Honour, however, entails responsibility, and the recipient, therefore, inevitably, has an obligation to discharge. He has to set himself an objective the attainment of which, or at least his endeavour to attain it, will further the cause of the Institution. I do not know what I shall be able to do. All that I can humbly submit now is that I shall strive to live up to the confidence you have placed in me and that in the performance of my task I look upon the co-operation and goodwill of my colleagues in the Council. It is the concerted effort of all and team-spirit which will lead us to the desired goal.

It has been the practice in the past for the Presidents to deliver a very learned discourse on different aspects of engineering practice in the public and private sectors and to comment on procedure and control in the execution of projects, Criticism of administration relating to service conditions has also been a subject discussed from this Chair.

I am not in a position to follow the example of my predecessors, most of whom occupied the highest positions in the field of engineering service, and had the privilege and opportunity of executing or guiding the execution of projects of far-reaching importance and benefit to our country. My position in this plane has been mostly that of an occasional observer — one who caught glimpses of great things but never had a hand in shaping them. Although during the past few years I have had some opportunity of coming in close contact with what is known as 'administrative machinery in the public sector, I do not consider myself competent to comment on their working. Candidly speaking, I have often wondered at the complex nature of administration and marvelled at any work being brought to completion through the maze of a myriad rules and regulations. I shall therefore confine myself to making certain observations on the tasks and problems facing the Institution, professional engineers, and Student members.

As I have spent the major portion of my life with students in general and with engineering students in particular, my approach to these questions is always from the teacher-student point of view. I use this compound word advisedly even though I realise that this is unorthodox. To those who believe that students and teachers have at least different, if not antagonistic, interests, hyphenating these two categories would certainly appear to be meaningless confusion. I am aware that such persons are not rare, only I shall hope that there are not many in our Institution. It is a fact that teachers and students belong to two different generations, and it is proverbial that youth and age do not look at the world with the same eyes. But can we never forget that teachers and students both have the same end in view? One has come to learn and the other is there to impart that learning. They are engaged in the same process, each doing his part but contributing to the same result. Their points of view might appear on the surface to be different, but the basic objective of both is bound to remain always the same.

To take the difference in the attitudes and views of the students and teachers as real would no doubt be a folly. And to expect that students must come to adopt the same attitudes as their teachers cherish, no matter how much the world has changed in the intervening period between the formative period in the life of the teacher and the present, would amount to a blunder. Such a desire results from the rigidity of our views, for it is a common human tendency to live in a static world unmindful of social dynamics.

This common failing, namely, that of losing sight of the human aspect of things, is revealed in another sphere of our national life. India since independence, has been in the throes of a struggle attempting to evolve a new world out of a world that had languished in the morass of slavery. The process cannot be a very clean one and any criticism based on time-honoured moral standards would not take us very far. Before independence, our own failures and shortcomings were ascribed to the exigencies of foreign rule, and now after sixteen years of self-rule, we are prone to lay the blame at the doors of the powers that be. No useful purpose can, however, be served by a recital of the too-patent charges. It would be more realistic to take an unsophisticated stand on the simple principle 'to err is human' and to bring in a little more of indulgence and human fellow-feeling. In our zeal for technocracy, we often lose sight of the human aspect of things and sink deeper into complications and get caught, so to say, in the spider's web out of which we are unable to emerge to meet the challenge of life.

This is true not only in the sphere of our relation with the students but also in the realm of our contact with others.

'आत्मानम् विद्धि' ('Know thyself') enjoins our philosophy. Although it is difficult of attainment, and probably it is not possible to know oneself fully, yet all the same I feel that one can reasonably try to estimate one's own limitations. Once we are in possession of this amount of sell-knowledge, it would be possible for us to place ourselves in the position of others. While impatience with the viewpoint of others leads to misunderstanding, the zeal for self-criticism often hinders progress. The latter is very much in evidence in our present national emergency. It is admitted that we have overlooked an important aspect of our international relations which has caused a good deal of damage and loss to our country. But instead of dissipating our energy in trying to apportion blame in a situation of emergency, we should in the first place decide on the course of immediate action relegating the issue of fixing the responsibility of failure as mere corollary to the proposition.

In building up a new India, particularly in this period of emergency, we are all faced with the same problems in our work of trying to provide men and women with the knowledge and skill that would go to meet the ever-increasing requirements of modem industry. It would be perhaps better if we classify these problems. We may divide them into two classes: first, those which primarily involve quantitative questions such as the number of engineers with qualifications of various kinds required on the one hand to meet the needs of expanding industry and on the other for the defence of the country, the ways and means of recruitment, and the most efficient and economical methods of arranging for their education. The second class is that of problems involving the question of quality — how people could be provided with the competence to deal effectively with a range of technical knowledge which grows at an ever-increasing rate, and how it could be ensured that in increasing the number of professionally qualified people intellectual standards are not debased.

Of course, the problem either of quantity or of quality is not peculiar to the field of engineering. It is in the nature of modern society that it demands not only larger and larger numbers in the established professions, but also the recruitment for a large number of entirely new occupations calling for professional standards, some of them in the field of administration, some in that of the social sciences, others in the world of finance and commerce, and so on. We in the engineering profession, however, are in a special position in this matter. We have an almost unique experience of the problems which arise in establishing the standards and methods of a new profession, the background of which is in part scientific, in part administrative, a unique experience also in educating men to take their places in the large and complex organizations on which our society increasingly depends. Our solutions to the problems of quality and quantity, if indeed we find any, can be applied in fields of work which on the face of it seem rather remote from engineering, and so any success that we may achieve will have an importance which would go far beyond our own immediate concern.

Our Institution — University Colleges

In almost all the countries, the criterion of professional recognition is graduation from an engineering college or the passing of some other equivalent examination. As regards practical training required for professional recognition, there are countries where no such condition seems to exist still. In countries where a certain amount of practical training is required to qualify as a professional engineer, there is a great variation in the length of the period — from 16 weeks in the Netherlands to 7 years in the United States. And only in the United Kingdom and the United States are both academic degrees and practical experience fully taken into account for official recognition of professional engineers. And the title of professional engineer once awarded, remains valid for life.

The requirements for professional recognition as set out by the Institution are characterised by a legal and static approach, and do not take account of the necessity of keeping in touch with current developments and maintaining the proficiency of each member at his highest level during his whole career. This static view, which was natural in the nineteenth century when the professional careers were shorter and the process of technological change very much slower, is to my mind outmoded. In view of the very rapid speed in which technological changes take place now, it is becoming clear that the knowledge obtained by an engineer during the period of his formal education is insufficient for the purposes of his whole career. The time has indeed come to recognize the necessity for continuous education throughout the career of the engineer. Until recently, the professional engineer was generally able to keep up with contemporary developments by private reading and attendance at occasional lectures. This is now becoming patently insufficient in view of the speed of development in innumerable fields of specialization. And so a well-thought-out system of refresher education and training will eventually have to be introduced to improve the quality and standards in the profession of engineering. This, to my mind, is one of the major tasks before this Institution.

To the professional engineer engaged in teaching, a problem which seems to defy solution is that of giving the student some acquaintance with the rapidly growing fund of knowledge in the field of technology, within the strictly limited time available, without on the one hand becoming merely superficial and on the other narrowly specialized. One ideal which is mistaken in my view is the supposition that a degree course must cover everything in one major branch of engineering, say, everything in mechanical engineering or everything in electrical engineering. In my view, it is quite useless to expect that this is possible within the time available or is even desirable. Similarly, I do not think we should regard the frontiers between these main divisions as being sacrosanct in any way. They are where they are, largely from historical reasons, which have little validity today. For example, I believe that a first rate undergraduate course can be designed round the group of studies which are relevant to both electrical and mechanical engineering and which form the frontier region between them. In this connection, it is significant that in those countries which have separate professional Institutions serving the main branches of engineering, as in the United Kingdom, there is now a discernible tendency among them to draw closer together in educational matters. The successful introduction of the so-called Common Part I Examination a few years ago is only one example of this tendency. Perhaps the conception on which they ought to be working in the next ten or twenty years is that of a single society to which all professional engineers can belong. Such a society might by that time need anything from twenty to fifty divisions to cater for the needs of everyone, though of course many of these divisions would have a great deal of common ground with one another.

We must recognize the fact that only a well-informed man can be a well-informed engineer and that this will not come about unless we take deliberate steps within our educational provisions to make it so. By educational provisions I do not mean merely our teaching institutions, I include also the domain of engineering employment. I fear that too often we regard these two spheres as separate and distinct and not as component parts of a single, continuous educational process. Unfortunately, I have noticed that during the last four or five years, the Governments, the universities, and the engineering institutions established by statute, not only do not approach the Institution for assessing and recognizing their degrees, but they do not even think it worthwhile to seek the advice of the experienced men of the profession. They think of the members on the staff of the educational institutions only as engineering teachers and of the others as practising engineers. They seldom, if ever, think of the latter as teachers, though in fact they have a vital educational role to play — that of helping to transform young men who have been taught the basic principles of engineering and whose minds have been attuned to engineering, into real engineers.

Be that as it may, the senior members of this Institution should seek deliberately and systematically to teach the newcomers what they themselves have learnt in the sphere of engineering practice. This will be a real contribution to the formation of the next generation of professional engineers. I would urge them to take this as a part of their professional responsibility. I feel that the Institution of Engineers should give greater emphasis to this aspect of engineering education. We will have to maintain and develop a belief — a conviction — that in the last resort it is the sense of responsibility, the example, the initiative and the inspiration of the individual which counts, and that only if the Institution as a whole embraces a sufficient number of such responsible individuals, will the strength and prosperity of the Institution be assured.

Student Members

Divergent industries and different wings of the Defence establishments require a large number of qualified trained personnel. In addition to 30,000 engineering graduates that we would be turning out soon, we have on the Roll of the Institution 31,343 Student members. If we can canalize this enormous manpower in the proper channel, it will go a long way in removing the shortage of technical personnel. The Defence Department, as far as I understand, has already made arrangements for providing the necessary facilities. The Institution has so long been working as an examining body only, leaving the problem of training to the efforts of the students themselves. I request individual members, particularly those in industry, to look to this aspect of the problem and to arrange for proper theoretical training facilities in their establishments. Members of our Institution will, I am sure, be glad to take part in delivering lectures on theory whenever the call will come. The Council of the Institution will, I hope, with the help of the 18 Local Centres, be able to chalk out a programme of work for this purpose.

I am glad to inform the members that should we organize evening classes in the engineering colleges and polytechnics all over India to prepare our Student members for our examinations, the Ministry of Scientific Research and Cultural Affairs is agreeable to give financial help for the purpose.

I might summarise what I have said:

1. It was important what the actual criteria were that allowed a person to commence his professional practice as a member of the Institution, but it is more important to encourage that person in pursuing studies during the whole of his professional career.

2. Education of the engineer in engineering institutions must stress the fundamentals and be strongly oriented toward the sciences without somehow losing the bias towards engineering. The engineer of the future must continue his education as a life-long process and not end it with the completion of his formal education.

In the developed countries, there is a ferment at the undergraduate level caused by the need to increase the scientific and mathematical content of the various curricula and the consequent squeezing or elimination of certain traditional skill courses. The consensus of opinion is that this trend will continue, and the responsibility for the practical training would be shifted more and more on to the shoulders of industry.

To fulfil that task, the universities and the engineering institutions will be well advised to seek the active help and collaboration of the practising engineers.

3. The Institution of Engineers should organize in recognized institutions part-time evening courses for our Student members, in collaboration with the Ministry of Scientific Research and Cultural Affairs

Finally, the Institution of Engineers has responsibilities to the public at large. It is surely the duty of any professional body to speak out in public about what is needed for the public good in the field in which its expert knowledge applies, and about what, if anything, is going amiss in that domain. In my view, at least so far as this country is concerned, the Institution of Engineers has been far too reluctant to let its views be known on questions of this kind. It has, of course, rightly been unwilling to get involved in questions which may be thought to be political. But the big issues of economic prosperity and industrial vitality are not really political, and there is none better qualified to give the public guidance on the broad technological questions involved than this great professional Institution.

In conclusion, may I say again how greatly honoured I am by having been elected by you as President of the Institution. Perhaps our discussions will show that much of what I have said fails to get general endorsement from even my colleagues in the Council. However, if by having put my own views before you, I have been able at least to generate some thought and to make you to re-examine some of your ideas, I shall feel, and I hope you too will feel, that the time has not been wasted'.

Presidential Address

(1963-64)

The Council has done me the high honour of electing me President of the Institution for a second year. I am deeply conscious of the distinction thus conferred on me. I shall do my best to discharge the heavy duties which thus once again bear upon me, and in this I depend on my colleagues in the Council for their advice and support.

I propose to take the Institution itself for the theme of my present address. Having with us as our Chief Guest an engineer who has attained the position of a Minister of the Cabinet of the Indian Union, I feel this to be a fitting occasion when to recall the devoted efforts, often in the face of great indifference and discouragement, of our early Presidents, Councils, Committees, members, permanent staff and other stalwarts, who gave so much of their time, wisdom and energy to build up this Institution on so sure and firm a foundation. They never lost faith in the great future which awaited it. By 1935, the Institution had attained sufficient prestige and importance to be granted a Royal Charter. Let not subsequent events cloud the significance of that grant. It was an outstanding event in, the history of Indian professional bodies, as it was the first Royal Charter granted to a body which had its origins and functions in India.

The prestige attained by the Institution and the service it had rendered through forty continuous years tended somewhat to be bypassed in the 1950's. I have pondered this problem and cannot but conclude that part of the blame for such developments must rest on the Institution itself. For reasons into which it will serve little purpose now to delve, it would seem not to have met the professional needs of engineers from all branches, thus leading to the establishment of other engineering societies. Many of you are probably aware of the efforts made by us in very recent years to effect a merger of these societies with the Institution, efforts which have not met with success.

It is, therefore, all the more necessary that the Institution remains continuously aware of the duties for which it was constituted. The objects and purposes of its being are well set out in our Charter. The very first of these, the promotion and advancement of the science and practice of engineering in all its branches, is so clear and comprehensive a statement of purpose that it should provide the guiding beacon for the activities of the Institution.

The Charter and the Bye-laws, a new version of which was adopted by the Corporate Members in General Meeting in October last year, are interdependent documents and should be studied jointly in our efforts to further the Institution's work. They, together, describe clearly, the limits of deviation within which it is intended that the Institution should function and progress. But because of this very clarity, the most careful study of them still will not give more than a knowledge of the bare framework on which the Institution's activities are built.

In the new Bye-laws of the Institution, great care has been taken to ensure that all branches of engineering and all interests of the Institution are fairly represented. The Council is assisted by a number of Committees, each of which considers and reports to the Council on matters relating to the particular activities of the Institution which lie within its own terms of reference. In the Council, each of these matters is again laid open for discussion to fresh minds, with perhaps a wider range of outlook, and the recommendations of the Committees are then either confirmed, modified or referred back to them for further consideration.

When a subject comes up that is of major importance and may profoundly affect the interests of an Institution, the Council appoints an adhoc Committee to deal as exhaustively as may be necessary with that one specific problem. Some of the outstanding achievements of the Institution have been obtained in this way.

Local Centres and the growing number of Sub-Centres playa vital part in the organisational and dispersion of activities of the Institution. The growth of the Institution has necessitated the decentralisation of activities under the control of the Council. Such decentralisation allows a considerable measure of autonomy to those in charge of the Local Centres in order that the needs of a large number of members so widely dispersed and of varied interests may be met satisfactorily. Meetings and visits arranged by Local Centres provide a stimulus to their members by the discussion of matters which are of special interest in their own regions. They also give an opportunity for such members to join in the corporate life of the Institution, a privilege which they would not be able to enjoy if all activity was concentrated at the Headquarters. The manner in which the Local Centres discharge their duties and seek to promote the higher interests of the Institution is a source of constant satisfaction. The honorary workers of successive Committees of the Local Centres have rendered collectively and individually meritorious service which is not generally realised. There is no doubt that the strength of the Institution will be in no small measure due to the activities of the Local Centres and Sub-Centres.

The real check on the health of the Institution lies in the figure for membership, particularly in the figures of Associate Members in whose hands the well being of the Institution will remain in the coming years, an to a lesser extent in the figures of Graduates and Students in terms of the distant future. I am glad to be able to tell you that these figures are continuously rising and at a steep rate. The membership stands at over 46,000 — a significant figure remembering that the Institution was founded on a strength of 138 members in 1920. During the course of this year, I expect it will exceed all other Commonwealth Engineering Institutions in numbers. The weight of its counsel has been increasingly felt in the Commonwealth Engineering Conference.

The job of ensuring that a high standard of entry into the various grades of membership intended in the Bye-Laws is being maintained. Here I may mention an important matter which is now receiving consideration. This is in the accrediting of educational qualifications for exemption from Sections A and B of the Associate Membership Examination.

There was a time when, the Institution's list of accredited qualifications determined the eligibility of candidates for entrance into the public engineering services. With the setting up of other organisations within Government, this position was whittled away, and the main purpose of accredition by the Institution today seems to be for the purpose of adjudging the entry of applicants for membership to the Institution. The result is that more or less identical work is being carried out by more than one organisation, which to me seems nothing short of a national waste in this very important matter.

I had, therefore, been thinking in terms of an Accrediting Board at a national level comprising representatives from the interested organisations such as the Ministry of Education and the Union Public Service Commission, which could act for the country as a whole. It is very much my hope that these proposals will take, shape during this year of my office.

The Associate Membership Examination conducted by the Institution was reshaped and enlarged in order to cater as fully as possible for aspirants in all the main branches of engineering, and came into operation in late 1961. It is intended to be a test of a candidate's knowledge of the principles in the branch of engineering he has preferred and of his, ability to apply these principles to practical problems. It requires a standard in these subjects at least equal to university degree standard.

A review of the Institution's examinations shows that far from there being any relaxation, there has been a definite raising of standards. It is all the more regrettable therefore that some of the State Governments are still not able to see their way to accord due recognition to the passing of Sections A and B of the Associate Membership Examination, and treat aspirants to the profession who have passed these Sections on par with engineering graduates.

I have thus far put before you material evidence of the growth of the Institution and of its activities and achievements. There is, however, another matter of no neglible importance to its members. This is the delicate question of 'status'. This is something incapable of being expressed in numbers or depicted in the form of a graph. It can, however, be considered qualitatively by the examination of appropriate evidence.

What exactly do we mean by 'status'? The status of such an Institution such as ours, I submit, is a measure of, the recognition and esteem in which the Institution is held by the general public and by the fellow societies in India and abroad. On the latter count, the Institution has already achieved considerable eminence. It is in respect of the former that I have certain anxieties.

This lack of recognition in the public mind in line with its actual activities and achievements is not so very difficult to understand as it appears at first sight. It is inevitable that during a period of far-flung growth of our nationhood as at present that a lag such as this should exist between achievements and public recognition. In the final analysis, the work of the Institution in furthering professional—and by this means, national—interests will not fail to make its mark. Therefore, it is both undesirable and unnecessary to overplay one's had in this delicate matter.

At the same time, it would be but proper to recognise the shortcomings we undoubtedly have in the Institution and set to work to overcome them. To mention one instance, one of the primary activities of the Institution is the publication of technical papers and articles. An unbiased scrutiny of published material reveals that while meritorious contributions have been made, a substantial percentage of published material has been in the nature of recapitulation or collection of already available knowledge or in the nature of general discussions without making specific further contribution in the fields concerned. I would urge that the vehicle of the Institution's publications should be more strictly confined to valuable material so that whatever is published is authoritative, original, or in some way throws a new slant on engineering problems. The Institution is no longer an infant to throw its publications open to descriptive writing.

It is, therefore, necessary that we do look into matters such as these which, collectively, does matter a great deal to the prestige of the Institution and to the effectiveness of the service it renders. It is with the thought of making this service a little more purposeful that I had broached, during the session which has just ended, to the Council three matters which had been occupying my thoughts for some time.

The first of these was in regard to the difficulties experienced by our Students in preparing themselves for the Institution examinations. These young men commendably arrange for their own practical training, but find real hardship in securing good theoretical and laboratory instruction. If facilities could be made available to them in the engineering colleges and in the polytechnics by the conduct of part-time courses in these institutions, it would serve an immediate purpose. I had discussions with the former Ministry of Scientific Research and Cultural Affairs of the Government of India, and was assured that the Government would not only welcome such a move but also extend financial help, as a measure of increasing the output of technical manpower. The Local Centres were thereafter asked by the Council to follow this matter up in their respective regions, but, regrettably, very little seems to have been achieved.

The second project which I initiated has met with greater success. This was a proposal to establish book banks at the engineering colleges under the sponsorship of the Institution, to provide a substantial base of text-books for engineering students in the prosecution of their studies. By this means, not only are the students immediately benefited, but, They also begin to develop a feeling of one ship with the Institution. I hope these students will become Students of the Institution, and thus begin their association with the Institution from the commencement of their professional career. Happily, this project, which also had to be pursued through the Local Centres, has led to some results, and book banks have been established at a few engineering colleges.

The third is the need to help combat early obsolescence of engineers by making readily available to educators and to practising engineers alike, recognised and top quality programmes of continuing education. I believe this to be one of the most important problems facing the engineering profession today. It is my belief that our Institution has an obligation to play a major role in any national programme of continuing engineering education and must move seriously and rapidly to organise refresher courses and seminars on important subjects of national importance. Here again, I have to admit that not much seems to have been achieved.

The States and the Centre are preparing their Fourth Five-Year Plans. Can we not, the educators and the practising engineers, hold discussions and seminars at all our Centres on those plans which are mainly engineering?

In admission of my disappointment over these proposals, I addressed the membership in a letter which was published in the last November issue of the Bulletin. The response to this letter has been very encouraging, and I would very much like to endeavour to bring them to some kind of fruition during the coming year.

Lastly, I call for a reaffirmation and rekindling of the strong sense of ethics and dedication to the observance of high moral principles that have characterised engineers in the past as the protectors of public health, welfare and safety. In the face of repeated disregard of ethical concepts and procedures in the fields of politics, business, and, unhappily, also at times in the profession, a mere reaffirmation of our beliefs is not enough. We must by precept and example and also by direct teaching, make our students aware of obligations they as engineers are about to assume. We must also demonstrate our sincerity by our own conduct and by participating and being heard on local, State and national levels, when matters in our fields of special competence that involve engineering responsibilities and affect the public interest are at issue.

The overall picture of the Institution which therefore emerges is one of considerable achievement along the road set out for it by the Charter and a very rapid growth in membership in the last few years, with an array of important and urgent problems lined up in its front at the present day. Whilst we can all feel proud of the growth in strength and achievements of the Institution in the past, there can be no room for complacency in the solution of these problems.

I want to acknowledge with gratitude the love, respect and co-operation that I received from the members of the Council and the Staff during the last year. I am deeply indebted to them.

I know I speak for all of the incoming members of the Council when I pledge our best efforts to further the policies and objectives of the Institution during our tenure, and I express to all of you, the members of the Institution, our deep appreciation for your vote of confidence.

Dr T Sen—A Brief Profile

Dr Trigunacharan Sen, an outstanding academician, a persuasive teacher, an ardent advocate of advancement of engineering profession and an illustrious Past President of IEI during 1962-63 and 1963-64 (AM 1944, M 1948, HonLF 1971) on January 11, 1998 at Calcutta, aged 93.

Born at Sylhet (now in Bangladesh) on December 24, 1905, Dr Sen obtained his first-class degree in Mechanical Engineering from the College of Engineering and Technology, Bengal (later converted to Jadavpur University) in 1926 and joined the same in 1927 as Instructor in the Department of Mechanical Engineering and continued for a period of two years.

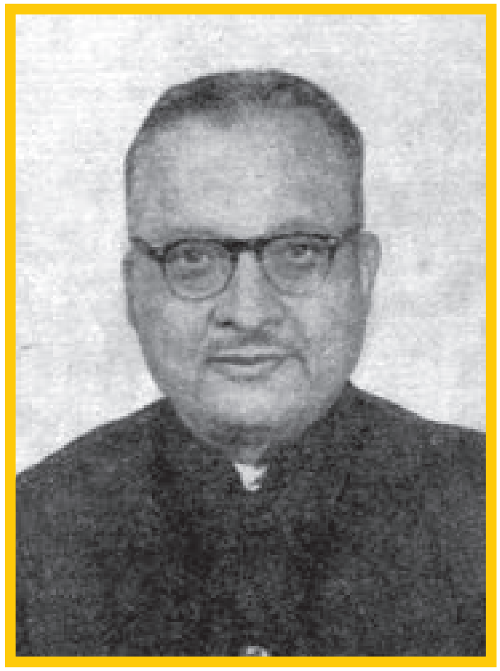
With a scholarship from the Deutsche Academic, Dr Sen went to Germany for post-graduate studies. He worked as Apprentice in the City Corporation, Munich from November 1931 to January 1932 and in the Water Supply Corporation, Government of Bavaria, till July 1932. While working, he also obtained his Doctorate in Mechanical Engineering from Munich in 1932, with specialization in Fluid Mechanics and Hydraulic Machinery.

On his return from Europe in 1932, Dr Sen was arrested under Bengal ordnance, put in a detention camp and after a year, externed from the then Presidency of Bengal. During the period of his externment, he worked as the Engineer and Manager with the Dibrugarh Electric Supply Company and finally returned to Bengal in 1943.

Dr Sen worked as the Professor and Administrative Officer at the College of Engineering and Technology, Bengal till November 1944 and later as its Principal. In 1956, when the college was converted to Jadavpur University, Dr Sen was appointed its first Vice Chancellor. He was also elected as Mayor of Calcutta for two successive years, in 1957 and 1958.

Dr Sen was awarded Padma Bhushan in 1965 and became the Vice Chancellor of the Banaras Hindu University, Varanasi, at the request of friend Sarvapalli Radhakrishnan in 1966. He was made Member of the Parliament (Rajya Sabha) and also the Minister for Education, Government of India. He also became the Union Minister for Petroleum & Chemicals and Mines & Metals in the year 1969.

Dr Sen had been connected in various capacities with several academic, scientific professional as well as cultural bodies. He had been Member of the 'Executive Council of the Inter-University Board of India; Member, Association of Universities of the British Commonwealth; Member, All-India Council for Technical Education, Government of India; Member, Central Advisory Board of Education, Government of India; Member, Council of the Indian Institutes of Technology, and also the Member of the Governing Bodies of Birla Institute of Technology and Sciences and Indian School of Mines, Dhanbad. He had been Vice President, Indian Association for Cultivation of Sciences; Member, Executive Council, Indian Science Congress Association; and also Member, Council of Scientific and Industrial Research (CSIR), He had been Member of the IEI Council; Member, The Institution of Mechanical Engineers, UK; Member, Indian Council for Cultural Relations; President, Indo-Czech Cultural Society; Vice President, Indo-Soviet Cultural Association; Member, Indo-American Cultural Society. He had been Director in the Central Board and Vice President in the Local Board of the State Bank of India; Director, Jay Engineering Works Ltd, Calcutta; and Director, Durgapur Projects Ltd, besides a Lieutenant Colonel of the National Cadet Corps of India.



Prof N S Govinda Rao

M.I.E

President 1965-66

Presidential Address

'Shri Chagla, colleagues in the profession, Ladies and Gentlemen,

At the very outset, I must express my grateful thanks to my brother members of the Council for having elected me as the President for this year. At this moment, I cannot but recall the names of the galaxy of engineers who have previously adorned this Chair bringing honour and glory to our Institution. President after President has expressed that this is the highest honour for an engineer in our country. This recollection of the past and the sentiments expressed therein brings home to me my own smallness. I feel humble. But then, thanks to the un stinted efforts of thousands and thousands of Corporate Members, the Institution has today attained a stature worthy of its gigantic size in the world of engineering. The President is like a stone on the peak of a mountain. Its presence at the top has no special significance as it is in no way different from the others. It happens to be there because it has the support from all the others below it. It is in this spirit that I accept this office. I look forward, sirs, to your continued cooperation in an even greater measure to serve the millions of our poor brothers in the country by raising their standards of living, by taking to them the benefits of our technical knowledge.

I will begin with talking about our own affairs. The elections under the revised constitution have been held both at the Headquarters and the Local Centres. Division Boards in all the seven Divisions of engineering were formed and have started functioning. The formation of these Boards, should be considered a historic event — an important milestone in the history of our Institution. These Boards are autonomous in their technical activities. The Institution today may be regarded as a Federation of Institutions functioning separately for each branch of engineering. Engineering and science are developing so fast, both in their intensity and diversity, that not only the barriers between them but even within them have crumbled. This has now been recognized by the technically developed countries in the West. Steps have been taken or in progress to bring about unification of the activities of the many separate Institutions in their countries. This is an extremely difficult problem, as unification means surrender of the independence of each one of the joining units. Prestige, tradition, and a host of other factors inhibit progress towards unification. To unite to gain strength is difficult, to divide to weaken is easy. Fortunately, in our country, our engineers in the past had the vision to foresee these difficulties and boldly decided to have only one Institution to represent all branches of engineering at the very outset. It is most important that we preserve this unique heritage of ours, and further strengthen our solidarity in the years ahead, if we desire to keep pace with modern advances in technology. Nothing is gained by weakening this structure. I earnestly plead to the Institutions working outside of us to consider seriously the consequences of working in isolation and the advantages of working in unification with us. We are happy that the Mysore Engineers' Association which was in existence for a hundred years, merged into our Institution last year. Like the mother who is ever ready to take her children to the fold, the Institution not only welcomes but earnestly desires that the others should follow suit and come to us.

It is usual on this occasion for the President to devote the major part of his address to a particular topic of his choice. Today, I shall speak on 'What factors should govern the philosophy of development of engineering education in our country'.

The first factor to be considered is obviously the one of history. You cannot formulate a policy in a vacuum completely divorced from the past. 'Engineering traces its beginnings almost to the dawn of human existence on this planet and would embrace the craft of the prehistoric hunter and his primitive attempts to make and use weapons. It would cover the endeavours of man to master the I materials available, from the Stone Age onwards, to direct the resources of nature to his own use and benefit. Throughout this long period of development, science, which is the understanding of the basic principles, played but a small part. Knowledge, largely gained from experience, was passed from generation to generation, mainly through a priestly caste.' (Technical Education by P. F. R. Venables, G. Bell and Sons Ltd., London, page 25). This has been so in every country of the world including ours. Technology is the father of science.

The second factor to be considered is, to my mind, the most important one. It is that we should link everyone of our national activities whether it is in the field of education, technical development, generation of power, irrigation, agriculture, or any other activity to the declared objective of our Government which is to build up a socialistic pattern of society. Every national activity should be construed as but one more link in the long chain forged for lifting high our standards of living. It should be based on increased production realized through the use of modern science and technology and on equitable distribution of income and wealth. Any scheme of technical education we propose should, apart from being suitable for all levels of general education, also directly promote technical development. The consequence of the scheme of technical education we frame should result, in a few years, in producing all the technical personnel necessary for achieving the targets laid down in the successive Five Year Plans, in respect of (i) increase in productivity, (ii) rise in income and living standards, (iii) diversion of a large number of agricultural labour, unemployed and underemployed, to more gainful employment in industries, (iv) elimination of the dependence on more advanced countries for equipment and technical knowledge, and (v) increase in rate of economic growth. Unlike general education, technical education is purposeful. In our socialistic pattern of society technical education should be such as to contribute largely to maximization of material benefits to all, rich or poor, in the country. Everyone should have more of food, clothing, housing, and all that make living more comfortable. People have suffered from poverty for centuries. They cannot wait any longer. The breaking point has been reached. It is imperative a shift is made in the policy of development of education — giving technical education at all levels topmost priority. This should be pone quickly—not quickly but immediately.

A history of the development of neighbouring countries like Japan, Russia and others shows that they began their development by giving all emphasis on technical development — in designing and fabricating equipment either based on prototypes purchased from the more developed nations or based on the application of technical knowhow published in the current literature of Those nations. The country cannot afford to wait for science in our institutions to develop sufficiently to give a lead to technical development. Development of basic and fundamental research in the pure sciences has to be on a scale smaller than technical development in the context of the conditions existing today in our country. The decision of the University Grants Commission to deploy their meagre resources in fostering one or two schools of research in each of the universities is a step in the right direction.

Having settled the objectives to be achieved and the priorities in educational development, the next factor to be considered is the choice of the personnel at the top level to guide and supervise implementation of the policies. In selecting the personnel it should be remembered technical development and technical education are like Siamese twins. Separate one of them, the other will die. These twin problems have necessarily to be handled by men qualified to do so. Who are they, if they are not engineers? It is strange that this obvious truth has been missed. What results can be expected if, for example, you go and consult a physicist, however eminent in his own field he may be, on the matter of developing, designing or purchasing an aeroplane. He may not even know the names of the parts of an aeroplane. This is true of any machine, any equipment used either in national defence or in industry, either in the public or the private sector. This seems even more extraordinary when the Government do have first-hand experience of success in employing engineers in schemes of technical development like the nuclear plant in Trombay, the antibiotics plant in Pimpri, Bharat Electronics and the Indian Telephone Industries in Bangalore, and a host of others. In the private sector there are innumerable examples. We are fully aware that our popular democratic Government has never worked in isolation, forcing their decisions on an unwilling people as it happens in dictatorial governments. They have always sought advice from persons in their individual capacities. This system has its own merits and demerits. Its greatest demerit is that the selection gets confined to a few—in fact, to a very few who dominate practically all important committees in the Government. May I suggest for the serious consideration of the Government that they should not merely confine their selection to persons who are personally known to them and who act in their individual capacities, but also invite nominations from a representative Institution like ours. It is in this way that they can come in contact with new talent. This gives them, eventually, a wider choice for selection. The Institution will form its own committees representative of the thousands associated with it and select their leaders to voice their opinion on the Government committees. In this way, Government will get to have a first-hand knowledge of the thinking of the thousands who are affected by their decisions. A high level policy making statutory or advisory body is the first requirement. Its functions have to be to coordinate technical development and technical education. It has to guide collection of data with regard to technical manpower requirements of all categories, and also to get the progress in all aspects of technical education periodically evaluated. It should lay down broad principles for recruitment of teaching personnel, training of students, writing of text-books, and encourage promotion of research for increasing efficiency and diversification of courses of technical education periodically in step with the advances made in industrial development in our or in other countries. It should ensure maintenance of proper standards. Its many other functions are to be discussed at the Seminar on Technical Education being held now.

The next problem is to work out the details of development of technical education at all levels.

We may as well start from the highest level—training of the management engineer.

It is no exaggeration to state that the technical development of a country depends entirely on the quality of the leaders who manage the industries. How important they are now and will be in the future can be gauged by what is happening in other countries. ' ...... the research department of Scientific American magazine has documented just how dramatic the rise of scientists and engineers in American industry has been. The findings emphasize, also, how fast it is likely to continue to be. Between 1947 and 1963, there was a slight but significant drop in the number of production workers. Yet during that period, industrial output rose by 86 per cent. Employment of scientists and engineers in industry more than doubled. During the first half of this century, the percentage of top U.S. management executives with scientific or engineering degrees grew from 6.8 per cent to 20 per cent. By 1963, it had reached 36 per cent.' (The Economic Times, Bombay, 2nd January, 1965.) What is true of the United States today will be true of us in the next few years. If we have to meet the demand then, the training of such engineers should begin now. Separate courses leading to conferment of post-graduate degrees in top management for persons with an adequate background of theoretical and practical knowledge of science and engineering have to be evolved. Those who have gained experience by dint of self-study and work in high managerial positions are a very valuable asset to the country. They should be gainfully employed in management of large engineering complexes (group of industries of an allied nature) like river valley projects, iron and steel projects, heavy machine building industries, and so on. In addition, their advice will be of great value to those who have to take policy decisions and implement them. It is unfortunate that while in other countries their value is getting increasingly recognized, they are in our country mostly relegated to second-rate positions. It is a matter of great pride and satisfaction to us that wherever technical men have been assigned top administrative and managerial positions, they have acquitted themselves brilliantly. At this moment, dozens of names are crowding into my memory. The most illustrious of them all is that of Dr. K. L. Rao, Minister for Irrigation and Power, and one of our distinguished Past-Presidents. It is high time that, if we mean serious business about technical development of our country, important positions which require rich and varied experience in administration coupled with a specialist knowledge of science or technology, like Secretaryships of engineering departments, Chairmanships of Boards of Management of industries, of electricity and of transport and other undertakings are assigned to men who have adequate knowledge of both management and technology, and not either the one or the other.

The second category who can actively promote development of technology are the engineer-scientist research workers. These are the men who can give a lead and a direction to technical development. The number required for this work is few but then the quality of work they do, either in the pure or the applied sciences, has to be of the highest order. The training of these men, leading generally to a doctoral conferment or a post-doctoral award like the Fellowship of a learned society, has to be in institutions specially created for this purpose. Engineering graduates will have to take basic courses in the pure sciences, and science graduates will have to take basic courses in engineering, before commencing a research career in this field. These are exclusive of those specializing in the basic sciences in the universities and allied institutions.

At least ten times the number of the second category required are the design and development engineers. The training of these men should be such that at the end of their training they are in a position to design and develop either independently or working in a team, either entirely new equipment, based on the technical knowhow in the published literature on the relevant subjects, or successfully copy and/or improve prototypes of equipment imported from abroad. This work in the present context of our development is so important that, like the Russians, we should offer special courses for this purpose leading to conferments of both Master's and Doctoral degrees, as also awards of Fellowships of learned societies. This is the category who will in a large measure be responsible for reducing if not eliminating our dependence on foreign 'knowhow'. A few of these should later get trained in the plants to work as consultants for starting big industrial projects.

An equally important category, is the industrialist engineer, whose number may easily be ten times the previous type. These men are to be trained for starting, developing and managing small-scale engineering industries, and courses leading to conferment of degrees have to be organized for this purpose.

Next comes the category of erection engineers specialized it the construction, management and operation of engineering complexes like multipurpose river valley projects, steel projects, heavy electrical projects, and so on. Various types of engineers who have fairly good knowledge in civil, mechanical, electrical, and other branches of engineering as we turn out from our colleges today are required to work individually or in a team with others. Training for these will have to be necessarily broad-based, perhaps with more accent on the practical side, than what we are having now. The number required of this type has necessarily to run to thousands.

Five or six times this number required are the technicians of the foreman type for erecting, operating and maintaining small groups of equipment. They should have perfect familiarity with the operation and maintenance of all the equipment they handle, coupled with intimate knowledge of the knowhow of erecting them. The present diploma courses are too general in their content with undue emphasis on the theoretical side. The number of courses offered now may have to be multiplied many-fold and accent given more on practical training. In addition, it is absolutely essential that these men have intensive training for at least two years leading to a degree in the plants or projects where they have to start and continue their professional career.

There will generally be at least a dozen skilled craftsman for every technician. These are the experts who can make any or all the components of an equipment or a structure. Technical development to a very large measure depends on the skill of these men. They form the foundation on which technology is built. The training given to them has necessarily to be thorough. Since these form the army of technical manpower of the country, careful and detailed planning is necessary for deployment of these forces in the required numbers, for the required types of jobs, to secure optimum efficiency in their utilization. This problem of training skilled craftsmen is interlinked with the problem of creating gainful employment and preventing underemployment of the vast manpower available in the country. New nomenclatures for the courses like management engineer, engineer-scientist research worker, design and development engineer, industrial engineer, erection engineer, technician and craftsman have been deliberately given so that the students taking these courses are psychologically prepared for the avocation they are to follow at the end of their courses. Employers can also easily pick the type of persons they want.

The last and certainly not the least is the category of persons who are generally classed as uneducated, defining education as the ability to read and write. The peasant who carries on with his wooden plough, the bullock-cart driver, the village carpenter, the blacksmith, and such others form this category. Technical education has to be carried to these people by suitable planning of extension work necessary for this purpose. There are many other categories of technical personnel who are required only in small numbers. They are not discussed here.

The next aspect for the policy maker is to consider how best the development of technical education can grow in the soil as it is today. Does it require the aid of fertilizers to increase its productivity? If so, what should be their constituents, the dose, the manner and the timing at which they are to be applied. These I shall now discuss.

The foremost one to be considered is that of finance. We cannot forget, in this context, that in 1962-63 our national income was Rs. 13,370 crores, and the per capita income was Rs. 294.7, and the number of school going children was 54.4 million. A very optimistic estimate would be to assume that these figures will get doubled by 1981-82. It is clear from this survey that our resources are poor and will continue to remain so, as rise in our national income will not be very much more than the increase in our population. Any proposal of a revolutionary character is out of the question. Psychologically also it is bad. Every change in policy we make should be such that its objectives are clearly defined and understood by the persons who are to give effect to it. In other words, the training of persons of the various categories mentioned above should be brought about with minimum additional recruitment of teaching staff buildings and specially equipment involving foreign exchange. Consolidation and reorientation of our existing institutions will have to take precedence over expansion during the next few years at least.

The next impediment to the execution of our policy is the low value attached to the training given in technical institutions. A student trained for three years in a junior technical high school after completing his seventh standard in a primary school, instead of being preferred for admission to a diploma course in a polytechnic because of his background knowledge of technology and technical skill in the crafts, is actually denied admission! The boy, unaccustomed to any hard work from the general high school is not only chosen but is actually preferred to the other type on the ground that he is good in the knowledge of the basic sciences. We are prepared to spend a good amount of money and labour in training this boy to acquire technical skills. If this is possible, I cannot understand why it should not be possible to spend a much lesser amount of money (training in the basic sciences costs less than training for the skills) to impart the necessary knowledge of the basic sciences in the same time now taken up for training the science boy to acquire technical skills. The same is true of the diploma students. They are denied admission to the graduate courses. No attempt has been made to give training to the diploma boys in the basic sciences in the same or probably less time and money now spent on training the P.U.C. boys in acquiring the technical skills. All that is necessary to effect this change is to redraft the present syllabi. When once this is done, its effect will be immediate. It will revolutionize the pace of our technical development. The first reaction to this important reformation is technical training will gain respectability while it has none now. When it is known that students with technical training are preferred in the matter of admission to the diploma and degree courses, hundreds of thousands lads anxious to have a technical career will join these courses at the craftsmen levels. The better ones amongst them can easily advance their technical attainments step by step. Those who cannot get admission need not join the army of the unemployed but immediately start earning their bread by the skill they have acquired. Today, there is great frustration amongst S.S.L.C. and P.U.C. students who are unable to get admission to technical institutions. The army of these unemployed is growing and their frustration is increasing. The change now suggested is not to completely shut out the admission of the boys with general training but only to give second preference to them in the matter of admission. In many countries, this is being done. Previous training in factories is insisted upon. In some countries sandwich courses have been started.

Technical education projects can succeed only in an environment congenial to its growth. At present, young children in their classes read books on general science which adults find difficult to understand. No wonder the science subjects are very distasteful to our children. These text-books have to be rewritten emphasizing mostly the applications of science like use of electric power for domestic lighting, making and use of fertilizers for lands, use of artificial yarns for cloth, making and uses of cement, bricks and so on, the things with which the child is familiar in his environment. They should be mostly in the nature of biographies of scientists. They should bring forth in their lessons the rational way of thinking scientists adopt for the solution of their problems, and the use they have made of natural resources like a waterfall, coal, wood, iron, and other raw materials for economic benefits. Young children should also be encouraged to develop their powers of observation in understanding how nature works and how simple machines work, and develop manual skill in making simple useful gadgets. The importance of basic education to the development of our economy cannot be overstressed. This idea is by no means new. It has been vigorously supported by Mahatma Gandhi, Dr. Zakir Hussain and others. The Ministry of Education has made a beginning, but it has been a very small beginning to make any impression on technical development. It therefore needs to be more vigorously pursued.

Another difficulty which has to be removed is the wide disparity in the scales of pay between the craftsman and the engineer at the top. It does not require any elaborate argument to prove that the entire success in the implementation of any technical project however brilliantly planned depends ultimately on the skill of the craftsmen who execute it. It is as difficult to acquire skill as it is to get a degree or even a doctoral conferment. The best worker is as important to the nation as the best planner. Since the numbers of the best in both these categories are small, the financial reaction of this proposal on industry is small while the gain in the quality of workers they can get is inconsiderable. The acquirement of technical skill will at the same time assume new dimensions of respectability.

Boys fight shy of taking up a technician's career not only because of the low scales of pay and the social status attached to it, but also because they have no chance of improving their lot. Once a technician, he remains so for ever, however brilliant he may be. He can never be an engineer: This has to be removed by developing on a large scale extension courses like holding evening classes and correspondence courses in plant training and so on. The Institution of Engineers (India), I am glad to say, is playing its part, in its own humble way, in offering hope where there was despair, prospects of affluence where there was poverty, social respectability where there was none, to those anxious to play their part in engineering the technical development of our country. Last year 776 students completed their Sections A and B of our Associate Membership Examination. This is by no means a big achievement considering the leeway we have to make to come up to the level of other advanced countries. Accelerated progress can again be achieved with minimum amount of expenditure on buildings and equipment if we throw open our numerous engineering colleges and polytechnics for training students in the evenings for our examinations. Retired engineers and others willing to do work in the evenings can be employed. Dr. Sen in his last year's Presidential Address announced that the Ministry of Education not only welcomed but was even willing to extend financial help to all institutions wining to take up this work of training students preparing for the Associate Membership Examination of our Institution. To you, Sir, let me on behalf of our Institution express our grateful thanks. The Institution in a modest way is helping this extension work by forming book banks in engineering colleges. On this occasion I wish to acknowledge the help rendered by the various donors to the Public Charitable Trust for the Advancement of Engineering Education and by yet others who have made generous gifts of books and equipment to the various Local Centres and Sub-Centres of the Institution.

I have also to acknowledge the munificence of the many State Governments who have made very generous donations both in land and in money for the buildings of the various Local Centres of the Institution. It may not have been possible to proceed so successfully with these constructions, which serve as foci of engineering activity in the respective States, without such ready assistance. Some of the State Governments have also made substantial contributions towards providing books and equipment at the Local Centres.

It would be appropriate if I take this opportunity to say a few words about the new Headquarters building of the Institution in Calcutta. The building in which the Headquarters is now housed was built in 1931 when the membership of the Institution was 1,200. An annexe was added in 1956 when the membership had risen to 15,900. Today, the Institution's membership is 52,000. The Headquarters has been suffering from a several shortage of space and the Institution hard pressed for funds, which have been used primarily for expansion of technical activities. The space problem became so acute in 1962 additional accommodation had to be rented. It was finally decided to construct a new multistoreyed building for the Headquarters as the only solution, and construction was started last year and is now proceeding apace. There is a serious paucity of funds, however, and I would like to express the hope that both the Central Government and industry will readily come to our assistance and contribute generously to enable early completion of the building.

Another factor which has inhibited progress of technical development, specially in Government departments, is the lack of insistance of those employed under them to keep themselves well informed of the latest developments in their own fields of specialization. I have personally known of many Executive Engineers who did not have a single technical book with them. Still they have risen to positions of Superintending and Chief Engineers and retired. Nobody seems to be worried about their technical efficiency. As pointed out by Dr. Sen in his Address last year, it is high time extension courses in the way of short term refresher courses or seminars, are organized and opportunity are afforded to such persons to attend them. In addition, suitable incentives should be given to them, specially to the junior staff, to join technical Institutions like ours, to travel to the places of our meetings and take part in the seminars, symposia and other technical activities. I am glad the Defence Ministry has already done so. The Education Ministries at the Centre and the States who of all others should be vitally concerned in seeing that their technical teaching staff keep themselves up-to-date by joining Institutions like ours or by other means have not yet moved in this matter. Many firms in the private sector have been very progressive. May I appeal to the many more to follow suit by giving incentives to their employees to join our technical activities?

Last but certainly not the least factor which is retarding progress of technical development is the poor quality of training imparted in a large number of institutions. There has been no effort to maintain an all-India standard of quality. It may be recalled Dr. Sen suggested last year the formation of an Accrediting Board at a national level comprising representatives from the interested organizations as the Ministry of Education, the Union Public Service Commission, and our own Institution, which could act for the country as a whole. Unfortunately, there has not been much progress made in this direction.

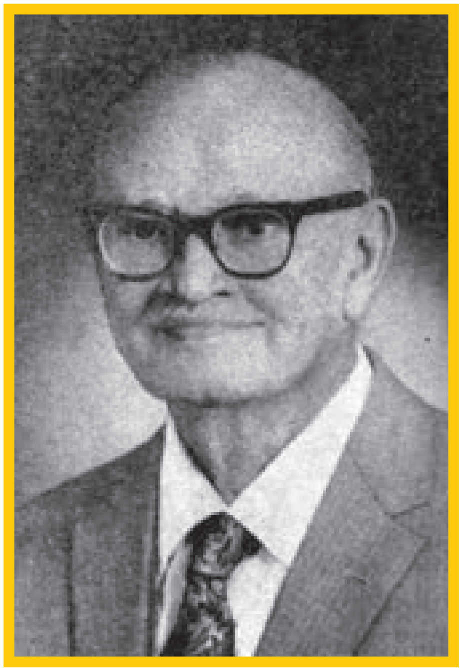
I have deliberately not gone into the details of the organization and of the courses necessary for the purpose. The policy now proposed is with reference to the present developmental environment, and there will necessarily have to be shift in the policy with the progressive technical development in the country. Policy-making should be dynamic in character. When once the policy suggested is accepted, the details for its implementation can then be worked out.

In fact, we are now having a Seminar on this very subject. I am happy to state that the response to our Seminar has been wonderful. Seminars on the same subject have already been held at the various Local Centres and Sub-Centres throughout the country. The total number of papers received at the various Centres and for the Convention here exceeds a hundred. It can easily make a volume exceeding 1,200 pages of printed matter. It is also representative of all types of persons in the Institution, directors, designers and planners in engineering concerns, professors and others in teaching and research institutions, industrial consultants and students. It is proposed to bring out a volume containing the views of the Institution on the various aspects of technical education, and present it to our distinguished colleague and Immediate Past-President, Dr. Sen, a member on the Central Planning Group set up by the Ministry of Education to draw up a perspective plan of educational development for the next 15 years, 1966-81.

Sir, we are extremely happy and proud that the Ministry of Education has included the Immediate Past-President of the Institution, Dr. Sen, in their Education Commission. Our experience in the past in this direction, I am sorry to say, has not been happy. More than blaming the Government, we should blame ourselves for this sorry state of affairs. We should ask ourselves, why is the Government rushing in for foreign consultants even in simple matters like a water supply project for a city? Why do they persist in keeping out our Indian consultants from big projects like the steel projects, though they are never tired of exhorting Indian consultants should be encouraged? Why is our Institution, representing as it does 13,000 graduate engineers and nearly 40,000 students — easily the biggest technical organization in the country — kept out of the councils of the Government in matters of technical development of the country? Why is it we have no representation in the Cabinet Scientific Advisory Board, and why not even in the Governing Body of the Council of Scientific and Industrial Research, in the Councils of the Defence Research Committees, and a host of other technical committees? The answer is not far to seek. We have not gained sufficient strength to make ourselves felt. Looking at our own history, we fought against a foreign power and got political *Swaraj*. It was not given but taken. Unfortunately, the slavish mentality of looking up to foreigners for everything technical persists. We must fight this out. Luckily we do not have an enemy to fight our battles. We have only our own brothers on the other side. All that we have to do is to convince by our achievements, our arguments, our behaviour and our strength that we are determined to achieve technical *Swaraj*.

Gentlemen, let me, as your elected captain of the year, call out 'Arise, awake and stop not till our goal is reached.

Jai Hind'.



Shri B P Kapadia

M.I.E.

President 1966-67

Presidential Address

Honourable Shri Yeshwant Rao Chavan, Honourable Ministers of Bihar State, Ladies and Gentlemen,

Before I begin my Address, I have to refer to the greatest tragedy in India that occurred in the twinkling of an eye on the 10th night — I mean the passing away of our beloved great Prime Minister, Shri Lal Bahadur Shastri; according to him, he had done his task and left us all to continue his good work. I fully associate myself with the sentiments expressed by my colleague. May his soul rest in Peace.

On behalf of the Institution of Engineers (India), I am grateful to you, Sir, for accepting our invitation to inaugurate this Convention in spite of the heavy demands on your time and attention. My thanks and pleasure are twofold, as I have the honour and pleasure of welcoming you from our State of Maharashtra, whom we liken to Chhatrapati SHIVAJI, on this occasion. We appreciate it more as we know, Sir, that you have the great task of defending our country in the present crisis. I also welcome the Ministers of this State and other distinguished guests and the members of the Institution, many of whom have come from over long distances.

I am greatly indebted to the members of the Institution Council for conferring on me the honour of being the President for the ensuing year am I shall do my best to be worthy of their choice.

It is a fashion on such occasions to criticise the authorities on every kind of subject and give sermons to the Government, without a mention of one's own poor performance and acts of omission and commission. Ladies and Gentlemen, if you are expecting me to provide excitement of that nature, I shall have to disappoint you. I shall have to refer to public administration in connection with certain matters, but shall do so with moderation.

Sir, you have all the information about our Institution in the brochures, we have given to you, but as you would need a great deal of time to peruse them, I shall briefly refer to a few outstanding facts of the Institution. The Institution was first inaugurated at Calcutta in February 1921. It was granted a Royal Charter in 1935 and it was the first Royal Charter given to a professional body which had its origin and functions in India. It has grown tremendously since and more particularly in the later years and today it has, on its Roll, over 56,000 members of whom the Students number over 40,000. It is one of the few Institutions of its kind in the world and the only one of such a size, and has members from all the engineering faculties, e.g., Civil, Mechanical, Electrical, Mining and Metallurgy, Chemical, Electronics and Telecommunication, Railway, Public Health and others, under one roof. It has 18 Local Centres and 14 Sub-Centres. The Institution is managed and governed by a Council elected by the members of the Institution representing all engineering faculties and all the States of the Indian Union.

In short, it has become a temple of engineering which emanates from its portals knowledge on all engineering subjects. Ours is an Institution of which the country may be proud of. I am glad to say that our Government has not been slow in recognising the importance and the usefulness of the Institution; your very presence here in this morning substantiates my statement.

If an Englishman who left India in 1947 were to visit our country now, I wonder if he would recognise the new India with its immense changes in industrial expansion, education, irrigation, power and defence supply and indeed producing every item of need of the country. Perhaps he may feel ashamed that his compatriots as rulers could not achieve in 200 years what we have accomplished in 18 years in the three successive Five Year Plans. In all these nation-building activities, our engineers have played their part very well; but now they will be severely put to trial in implementing the Fourth Five Year Plan.

Defence

Coming to the engineering subjects in the order of importance, the main task of the engineers today should be to defend our country and play their full part by supplying the requisite manpower, carrying out defence research, making designs, manufacturing defence equipment, building roads, bridges and aerodromes in the quickest possible time, without depending upon foreign countries for aid.

In the beginning there were many resignations from the recruited engineers but by proper screening and very hard training and suitable tests, they have withstood the rigours of climate and undergone every hardship for the defence of their country. Many of our engineers have joined the various units of the Technical Corps of the Army, and also worked behind the scenes in the ammunition factories and workshops which have contributed none the less in the achievement of our victories. They have sacrificed their lives so that others may live. On behalf of the members of the Institution, may I give an undertaking that whatever services and sacrifices you shall demand, we, the engineers, shall not fail to give them under any circumstances.

General Patton's soul must be turning in his grave at the present time as he must have come to know by now that there is a *bazar* of his broken down tanks, a creation of his genius which were considered invincible, till by the skill and bravery of our able officers and brave *jawans*, they came to grief like toys. This has given not only a surprise but a severe shock to the Western countries. Our engineers have built roads and bridges at high altitudes; they were always at the front line and have paid a heavy price.

The only way to make our country self-sufficient in arms is to associate private enterprise in the manufacture of Defence equipment. In this context, I would appeal to you to not merely follow the advice of professional military advisers on the grounds of 'secrecy' and so on. Take courage in your own hands and do this and I have no doubt about its results. If you invite private enterprise to associate with you, do not treat them as outcastes or black-marketeers, but as your equal partners in the defence of our country.

I must congratulate the Defence Minister for giving facilities to the military engineers to attend our Seminar and help the Institution in its deliberations. Such an encouragement is necessary from the other Government Departments and private enterprises also. A large number of military engineers, both junior and senior, are joining the Institution every year and I take this opportunity to express our thanks for their contribution to the affairs of the Institution.

Food

Coming to the item next in importance, which is also the crying need of the day, namely, Food, I believe that the Third Five Year Plan which is expected to be completed soon, has been disorganised and truncated due to the National Emergency and we shall have to make up the considerable shortfall before attending to the Fourth Five Year Plan. It is heartening to know that in the Fourth Five Year Plan the greatest emphasis is laid on agriculture. It is a well-known fact that most advanced countries in the world owe their prosperity and rise to agriculture. The U.S.A. and the U.S.S.R. are the biggest agricultural countries and it is the agriculturists who hold the power of foreign policies and guide the destinies of their nations. In our land too, as one of the greatest agricultural countries, it should be in the fitness of things that agriculture and land use be scientifically developed. This item of our Plan programmes should be put on a 'war footing'; just as the whole of India witnessed during the Emergency, when there was a tremendous enthusiasm in every part of the country and our *jawans* felt proud to fight and give their lives for their country. I regret to say, however, there is no such national feeling and realisation regarding the vital necessities of life and unless we achieve the target of self-sufficiency in food production, all other industrial and power plans will not have much value. No nation can fight or produce anything with empty stomachs.

Land reclamation projects, land and soil conservation schemes, maintenance of old irrigation works and canals; sinking of more tube-wells, re-vitalisation of the filled-up tanks and such other minor works all over the country, if properly carried out, will increase the production of food considerably. It is no use comparing the success in every branch of engineering and technology of the other countries to show how backward we are; instead of that, every engineer should consider that something has got to be ·done.

I have to observe that as far back as the First Five Year Plan, it was heartening to hear our beloved late Prime Minister, Jawaharlal Nehru, say to the nation that after a couple of years, we shall starve to death but we shall not allow a particle of grain to be imported from the foreign countries.

હમ ભુખે મર જાએંગે લેકીન એકભી દાણા બહારસે નહિ મંગાએંગે

There was an all-round enthusiasm created by his dynamic personality: all possible land was cultivated and food production had increased; but later on, as is usual with our people, the tempo of enthusiasm dwindled, and today we are not in the same but a greater difficulty. I am aware of the fact that since that time, our population has increased and that has also contributed to the scarcity of food, but I say forcibly that it is a normal thing in the life of India and our planners and engineers ought to provide for it.

I submit to this august body that our engineers should at the present time evolve short-term plans without waiting for long-term plans and achieve immediate results in production of food. It is no use blaming the Nature for sending less rain and then cry about food; as far as I know, God has been sending the same amount of rain all these hundreds of years but in certain cycles which we have not studied scientifically for want of sufficient records. I feel personally amused to read big headlines in the newspapers about boats plying in the streets of some cities due to so-called excessive rainfall; I have seen this phenomenon during my lifetime so many times from my childhood. There is a proverb amongst us that 'We are used to dig well only after the fire has taken place'. Shall I say that it is better to dig wells now and guard against the second fire than dig no wells at all ? How many thousands of miles of rivers are, at all times, flowing with abundant water in all parts of India, irrespective of rain or no rain, and it is up to us, engineers, to tackle these river waters and use them for agriculture. No doubt we have embarked upon and executed in the three Five Year Plans many irrigation projects, minor and major successfully, and converted vast dry areas into fertile lands, and yet all this is not found sufficient. A simple idea has been given to me for consideration, which will not cost a large capital outlay and that is to supply water for irrigation for half-a-mile of land on either side of the river banks. The idea is to have two barges—one fitted with not very powerful pumps to pump water from these rivers to both the banks as and when required and the second barge to be used for staff and keeping stores. We all know that our farmers are very clever and they do irrigation on either bank of the rivers, wherever the levels permit, by diverting the river water, but there remain huge tracts of land uncultivated.

I know one engineer, who is over 80 years old and is living in a forest in a small hut for the last 10-12 years, propagating and proving successfully his theory that there should be no classification of land as forest land, where only grass and jungle trees can grow. He submits that by providing bund and terracing and using every drop of water from the natural sources, every kind of crop can be raised and famine will disappear. Provision of bund and terracing is an ancestral method, and this may be a fantastic claim. But it is very useful information for the purpose of investigation and may increase agricultural production. I shall see that the Institution helps him.

Such simple ideas are not unworkable and I say that 'Where there is a will, there is a way'. I shall not touch upon fertilizers and so many other matters connected with food, except to observe that more research is needed to produce some substitutes with indigenous materials, even if they are only 50% as effective as the conventional fertilizers.

We were fortunate in having a Convention of International Council of Scientific Unions (I.C.S.U.) which was concluded only three weeks ago in New Delhi. They have forcefully recommended the use of scientific methods to raise food output. I have every hope that the recommendations of these expert scientists will be implemented immediately, irrespective of finances involved to increase food production.

The application of our development strategy to attempt to promote agriculture and heavy industrial expansion simultaneously must be revised Immediately. The strategic nature of our agricultural tendencies is primarily responsible for our low food production. Rigid and restrictive controls in all matters of economy including food can never effect the desired output.

I would like to draw your kind attention to the report of the Study Groups, published a few days ago, which stated that 80% of the necessary technical know-how is available indigenously in the branches of chemicals dyes, power, aircraft, mining, petroleum, paper, textiles, fertilizers, etc. Our engineers should select only a few out of these and become specialists in those, just as the medical men specialise in certain fields only. It is time that the Government realise that the Chief Engineer of a department should not be expected to know all branches of engineering. If he is given the charge of subjects in which he is not qualified, the result shall be obvious. One of the excellent recommendation of the Study Groups is to suggest that 5% of the turnover of all industries should be set apart for research and developing technical know-how.

Education and research

Fortunes are spent in foreign countries on research. Research is the lifeline of any nation; and specially in a developing country like ours, its importance is too well-known to be magnified. No amount of money should be considered sufficient for research equipment. Prospects of economy discovered by research will more than compensate the amount spent on research. The Institution has formed a Research Committee but the task is too gigantic to achieve any practical results by a private voluntary organisation like ours.

Along with agriculture, technical education and engineering research should receive high priority. Our Institution is not lacking behind in recognising the importance of technical education and has taken appropriate steps to fulfil the tasks it has set for itself. It is not a mere accident that since the last two years a number of seats in the Council have been occupied by the Professors of engineering colleges. This is a departure from the past. So the Institution has a ready-made reservoir which can be utilised in spreading technical education. It is time that our engineers, engaged in teaching, come forward to serve as the honorary instructors in technical institutions, both private and public, just as the doctors do honorary service in the hospitals and other private institutions. Under the able Presidentship of Dr. T. Sen and my immediate predecessor, Prof. N. S. Govinda Rao, a Committee on Engineering Education and Research had been appointed; they had held discussions in several meetings and a report has already been submitted to the Education Commission appointed by the Government of India. I have no doubt that it will receive due consideration. More practical technical education should be the keynote of all our education projects. No doubt, during the last 16 years many technical colleges and schools have been started. However, it is a well known fact that they are not adequately equipped nor supplied with talent teachers.

Consultants

There are a number of firms who have started consulting engineers' practice but I regret to say that they do not receive any encouragement from the Government. Our engineers are unnecessarily blamed that they are not good 'consulting engineers' and they do not know the know-how of the specialised aspects of engineering for which the Government has to seek foreign collaboration and spend a large amount of valuable foreign exchange. May I ask what steps the Government has taken to encourage these rising firms of consultants? Even if we do need foreign consultants our present approach is totally wrong. The Government directly deals with the foreign consultants and sometimes, but not always, asks them to take an Indian firm of-consultants to work along with them. May I submit, Sir, that this is just the reverse of what should be done. If the Government is serious about it, they should first select a firm of Indian consultants, perhaps in rotation. We are all aware that we are not experts and able to give consulting advice on all engineering subjects, but even in such a case it is the Indian firm of consultants who should be allowed to select and take the help of foreign consultants of their choice, to teach them technical know-how. The obvious advantage of this method will be that the foreign consultant firms will not be so independent as they are, when appointed by the Government, in carrying out their duties and the training of Indian personnel; but if the Indian firms of consultants appoint them, their bargaining power will be much greater than that of the Government and they will get the best possible economic terms out of them. In doing so, Indian firms will run a competition in appointing them; they will have an upper hand in starting new ventures and they will be able to extract more work from the foreign consultants than the Government by providing them with all kinds of, facilities over and above their huge, fees.

It is derogatory for Indian engineers to go begging to foreign firms for selecting them as joint consultants in a project and in doing so, naturally, they will not be treated well. If today there is a shortage of Indian consultant experts for giving advice, the fault lies with the Government. What has it done to encourage them? I submit further, Sir, that in the initial stage, the Indian firms should be subsidised liberally and given financial help to enable them to employ adequate numbers of technical personnel. Sir, last year we learnt with great shock and amazement that huge fees were to be paid to foreign consultants for the preparation of mere drawings and designs of the proposed new Steel Plant. It is a sad commentary on the administration that fantastic fees should be so spent, when we are Short of foreign exchange, just to get designs and drawings. After having the experience of five large steel plants, during the three Five Year Plans, and after spending large sums for training our personnel in foreign countries and in the execution of the steel plants, should we not have learnt the art of designing the steel plant? May I say, Sir, that it is not so. We have learnt them but we have not sufficiently recognised; the reason being just what I have stated that in the selection of foreign consultants, the Indian firms have been given no place for the choice. It is not necessary to go far to support this statement except to quote that our pioneers in the very first steel plant, when India was totally ignorant of such technical knowhow, the Tatas of Jamshedpur, started in the right manner, appointed their own consultants as their employees, and for many years now there is not a single foreigner employed or working in their plant at Jamshedpur, except in some recent expansion contracts.

Similarly, in all subjects of engineering, whether Public Health, Mechanical, Electrical, etc., the Government has only to bring up firms of Indian consultants to practise their knowledge. If the Government do not do that, who is to do it? If these firms are given encouragement, I am confident that in the next five years there will not be any need for foreign consultants. The Indian engineers did not know the art of laying oil pipelines in the bed of the sea, but the Chairman of the Bombay Port Trust very wisely made a condition in the tender that the foreign firms must take Indian firms as partners, and today, I am glad to say that the Indians have learnt about the laying of pipelines in the sea and we shall not need any foreigners for similar projects in the future.

Engineer-administrators

For several years now, we have been agitating about non-technical men being put at the head of engineering projects. In the previous Conventions, the subject of management of technical projects by the civil administration was forcibly brought out. As very little has been done on these representations, I have no alternative but to repeat the argument put forward by my predecessors, but with even greater force. It is inconceivable that a civil administrator should be considered as a superior human being and better qualified to be at the head of purely technical projects. The result has been that economy, progress and output of the projects suffered by 10-20%. It is true that they are very efficient officers and I may say that they are 'wonderful' as far as civil and other nontechnical departments are concerned, but I would certainly say that they cannot be said to be qualified to manage the technical projects. It takes considerable time for the technical officers working under the civilian to make him understand what it is all this about, and they generally have to leave them to it to manage or mismanage the project. He cannot know which staff is qualified for what job. When he inspects a technical project, it is beyond his capacity to realise whether anything is radically going wrong, leaving aside the theoretical and the scientific aspects of the problems. Our technical forces are the primary weapons with which we have to fight poverty and disease. A technical man loses heart by working under a civil administrator. Unless there is a perfect co-ordination and co-operation between the head and the technical executives, the desired objective cannot be achieved economically or in quick time.

At present there is a great unrest amongst the engineers regarding the downgrading of their status and scaling down of their pay, compared to the other cadres in the civil administration. Sometime ago, there was 'mass' resignation of over a thousand engineers in one State but further action was patriotically postponed due to the Emergency. There are similar petitions and representations in two or three more States. The Government should take a note and be warned of these tendencies before the unrest takes a stronger turn or before the fever spreads to the other States. The Institution believes that their grievances need to be properly investigated and justice done. It is not only the scale of pay that matters so much, but also the status which is downgraded.

Our Five Year Plans were not meant for administration of Law and Order by the civilians. This 120-year old system of rule by the civilians should cease forthwith. It is a wrong conception that the I.C.S. administrators are 'men of steel', because they are really not so. It is a layman's idea to say that as technical men are required in the execution of the projects, they should not be wasted in civil administration. I submit, Sir, that an engineer, by virtue of his training, is a better qualified person to be a Minister of the Union or the State than a politician. When technical problems in public works or projects or plans are put before him, he does not waste time in understanding the problem or has any need to be guided by a civilian, but he comes down to 'brass tacks' and passes proper orders. When I speak of engineers, I do not necessarily mean only the P.W.D. or Other Departmental Chief Engineers, but also the engineers from the private enterprise. It is high time, Sir, that the Government take a decision for associating engineers from the private sector in the execution and administration of the Government projects. You must move with the times and change the old-fashioned system with a bold and strong hand. The technical decision on any project should not be in the hands of a single I.C.S. or I.A.S. man or a politician. It is gratifying that recently the Government has acknowledged the merits of engineers and appointed one of our eminent engineers as the Minister incharge of Irrigation and Power at the Centre and another as the Governor of a State. Even our simple suggestion of making the Chief Engineers as Secretaries of their Departments is not acted up on except in one State. Our scientists and engineers must be appointed as Secretaries of the Departments as they are more suited for the task than the I.C.S. or I.A.S. person.

Now what is to be done by the engineers to make the Government move in the matter? There are two remedies that suggest themselves to me: (1) Engineers should form a union of their own and resolve that none of its technical members of top rank shall serve under a civil administrator, I if there is a competent and qualified engineer to do that job. I do not suggest that they should all resign and put the country at a loss but they should ask for transfer, leave, etc. ; and (2) Engineers should seek election in the Lok Sabha and the Rajya Sabha, as these are the only places where complaints receive proper attention, and these Sabhas can force the Government to enforce their will and make the necessary changes in the administration by law. I may inform you, Sir, that there is already a move and some of our engineers have resigned and are preparing for seeking election to the Rajya Sabha and the Lok Sabha. I may inform you and the members of the Institution that I shall support such moves and give them every kind of assistance. To review the work of a highly qualified technical man by a non-technical person is, on the face of it, fantastic and unworkable. It is no consolation to say that it has worked so far so why not continue? My reply to that is that you should investigate at what cost to the nation bas it worked before expressing an opinion. The main problem is to have an administrative set-up which can deliver the goods and the conclusion is irresistible that the training and education of persons to be recruited to the administrative services must have a core of realistic technical knowledge to be able to do justice to their job.

Whenever the Government has tried the management by engineers from private enterprise, the results have been most encouraging. There is an example existing today where one of our eminent engineers is serving on one-rupee-a-month on a big Heavy Equipment Project. He has brought order out of chaos and his achievement has been outstanding. The key for his success was that he was given full powers and he had not much interference from the Delhi offices.

Unless the private sector engineers are taken in Government offices for consultation or work together with Government engineers, no technical project can be successful in all respects. Many times engineers are rightly criticised that the estimates are revised so many times. I know some of the Chief Engineers who deliberately do this under-estimation with a full knowledge that it has to be revised soon. When I questioned them about their dishonesty in this regard, they promptly replied that if it was correctly estimated, it would never have been passed by the Finance Department. If that is the state of affairs, what can you expect? It is also true that many of our estimates are made without any proper study—whether it is the cusec. or the calculation on strength of structures or the financial background. May I suggest that our Chief Engineers should be told that after preparing the final estimate, about 15-20% should be added for mere ignorance and I am sure the estimates will be about right.

The Government should take advantage of the Institution by entrusting the investigation and consideration of important problems through the Institution's committees which consist of both officials and non-officials. The Government can grant funds to the Institution toward the expenditure of preparing such reports. The Government Chief Engineers usually appreciate the value of reports coming from a representative body like the Institution. The Government engineers in high position should consider it a privilege and an honour to sit by the side of their junior members in committee meetings of the Institution for deliberation on technical matters.

Engineer-contractors

On occasions such as this, the new President speaks more on the subject he is familiar, in which from his own long experience he is considered as an authority, and hence I must express myself at length on the roll of private enterprise and contractual relations in the execution of Five Year Plans. In doing this I may be excused if I have to repeat what I said on this subject in a Seminar at New Delhi. It is suggested and it will be unparliamentary, if I say that the Government can save the middle man's profit by doing away with the ready-made organisation and machinery of contractors' agencies, who can deliver the goods without much trouble. In my 50 years of experience as a civil engineer and a representative of a contractors' firm of capitalists—and as a matter of fact, I am a very practical engineer—I had to come across all kinds of engineers and administrators over and above my huge administrative staff and I am proud to say that I had the art of managing all of them. In doing that I got to know a very good cross-section of humanity and temperaments of all kinds. Many years ago, the profession of contractors was in the hands of a few competent mistries employed by some capitalists. When we look at many historic old buildings, we must say that they did their job very well.

It is often forgotten that the profession of contractors has advanced considerably during the last 20 years, and in it today there are all kinds of talents for design and execution. It is these talented and experienced persons who are not usefully employed by the authorities of projects in the public sector or by the employers of works in the private sector. There is no harm done in consulting contractors' engineer before the specifications and drawings are drawn up and detailed plans discussed freely. This, if done well, will ensure that the project that is to be carried out is based on sound economy and good engineering. This is the common procedure in many foreign countries in the case of large projects. Unless the contractors are trusted and taken into confidence, it is always a tug-of-war between the contractors and the employer's engineers, each trying to out-do the other. This results in increased cost of construction.

It cannot be denied that it is so and it will be impossible to carry out large projects without the help of contractors; hence it is high time that this important aspect of the construction industry is kept in the forefront and receives its due place in the planning and execution of the Fourth Five Year Plan.

When we are short of so many things, it will not be prudent for the authorities in charge of projects not to use the services of the trained and skilled personnel of the contractors' organisations for any reasons whatsoever. If there are any shortcomings in these services, they have to be improved and put right, by guiding them correctly and encouraging them. If the contractors can relieve the authorities of most of the anxieties of execution of a project, it is to be always welcomed; those incharge of projects can then devote more time on so many other things they have to do on so many problems of design and for the development of the project after its execution. If the Government staff are free to think, they can always apply their minds on how to economise in the design and cut down cost.

The biggest single problem of the construction industry at present is a fair and equitable standard form of contract agreement. The absence of such a standard form of agreement results in disputes and national losses.

The present standard forms of contract are generally based on those which were in vogue before the country became independent. Forms which had been evolved by the ruling power were obviously designed to suit the administrative set-up which prevailed at that time. The contractor was treated as an inferior party and not as an equal. The entire approach in all the conditions of contract was of suspicion and mistrust.

Although the country is now independent, the contract conditions have not been radically altered or modified to suit the present-day concept of a democratic society. The general approach of suspicion and mistrust still continues, and in all public sector works, the conditions of contract continue to be one-sided. Economy in the construction industry can be achieved only by keeping good contractual relations.

It is essential that a contractor is treated as an equal partner in every form of contract and given the respect which is due to him. All the conditions which favour one of the parties must be removed and made equitable. No authority should be given absolute power to take a decision against which there is no appeal. A decision taken by an engineer should be subject to review, where necessary, by the next higher engineer authority or by arbitration and there should be no interference from any non-technical external agency. The approach should be of mutual trust and confidence.

Considerable progress has been made in the formation of a standard form of contract agreement as a result of agitation by the Builders' Association of India for the last 24 years, and it is about to be finalised. Several Government departments have also formed Special Committees for the same purpose. The Builders' Association of India has produced one such document.

The change-over from the present 'bureaucratic' form of contract to those which eliminate one-sided and unworkable conditions may, during the period of transition, cause some difficulties, as it will necessarily involve a change of mental outlook; but the situation will have to be faced with courage and confidence. The conditions which will be brought about thereafter are bound to be satisfactory and will more than justify any initial hurdle which may appear during the process of evolution.

It is very common to see on heavy projects the big books of 100% specifications, rightly named as 'the Bibles' of the project. It is amazing to find that in contract agreement all kinds of labour amenities are to be provided strictly according to Government Labour Laws, which are very prominently absent in Government works. I can quote many instances of colossal waste of money by unnecessary, strict, unworkable and some times wrong specifications.

Very often, due to unnecessarily strict and wrong specifications only a few tenderers quote, sometimes none quote at all, with the result that the owners are forced to do the work departmentally which cannot be always economical. Considerable loss occurs on the provision of supervision for lack of trust on the contractor by the employers. For example, if the employers have 12 supervisors, the contractor has to employ another 12 or more to match them, which is entirely wasteful.

The distrust of the contractors is not the only factor that makes the project more expensive, but it may look strange that the distrust of the owners or Government engineers by their superiors is also an equally important factor in the increased cost of the project. Due to this distrust, the Government's or owners' engineers are nowadays very reluctant and afraid to exercise their own independent powers legitimately or properly, because they are afraid of being suspected by their superiors. They shirk to perform their duties, and in trying to do that, they do not hesitate to put the Government to loss and also to cause injustice to the contractors.

Such a frustration of Government's and owners' engineers is a great tragedy in the present administration of India after the independence.

There are other reasons also for this frustration. 'Over-centralisation' must give place to 'de-centralisation'. There should be no interference from administrative, financial and audit authorities or from politicians. These factors result in delay of decisions, which, in turn, causes delay in payment and consequently increases construction cost. Power must be delegated to the engineer officers, and they must be left free to exercise initiative and judgment if works are to be executed speedily, efficiently and economically.

Sir, I am not giving away any of your secrets when I say that due to your broad outlook and policy of giving full freedom to the defenders of our country without any political interference of any kind, we have dealt a crushing blow to our enemies and have brought fame to our Motherland. As you had full confidence in your Generals, may I request you, Sir, to have confidence in your engineers and allow them freedom in the, discharge of their duties without any interference of non-technical persons? I have no doubt, if that is done, there will be considerable saving in our financial layouts and quicker results in all our national undertakings.

The present concept of audit is outmoded and must be done away with. The present system should be replaced by a more rational one which does not result in delays in payment, with consequent increase in costs, slowdown of progress of works, and so on.

The detailed cost of departmental work is very often not correct, or not produced at all. Sometimes fantastic figures are given which are too good for belief and" if the details are challenged, these are not produced, because the costing never shows all the items of expenditure which has to be incurred and which the Government has also undoubtedly incurred but not shown.

The department should consider the contractors as a part of the Government organisation; and if they give their co-operation at all stages and do not adopt belligerent attitude, good results can be achieved.

During the pre-independence days, the contracts were based on a certain concept of 'contractual relationship'. It must be known to many that this relationship had often given the contractor the facilities not to provide , any supervision at all, and the work was managed by the owners' supervisors, who also prepared the bills and looked after the interests of the contractors. After independence their concept should have completely changed. But unfortunately, though it is considerably minimised, it has not fully changed. I will briefly touch here upon this aspect. We usually hear about corruption in the works of contractors. No doubt there is some truth in this observation, but does this not prevail in other business also including the Government Departments? At the same time, it must be admitted that the execution of works by contract offers less chances for corruption than when handled departmentally. In the works executed by contract, opportunities are few; but in the departmental works, it opens up all venues such as purchase of material and machinery spare parts, and all kinds of stores, fixing up of labour and transport contracts, and other items of supply for departmental works.

I lay great emphasis on the honesty and integrity of engineers. Honesty does not rest only on financial considerations but it includes dishonesty of purpose. When you know that some designs or proposal is definitely not practical, wasteful and un-engineering, and do not come forward to express it but say 'Yes Sir, this is wonderful and the best of all other proposals'—that is the 'father' of dishonesty.

Our profession is an easy and convenient target for accusations of corruption and malpractice. The main reason is that the engineers by profession have to handle large sums of money than in any other profession. It is not the monopoly or birth-right of any other individual to give a sermon on the honesty of our contractors' engineers. I am glad to say that this evil amongst engineers is not greater, perhaps much less than in the other professions and commercial establishments, where the number of such occasions may be less but amounts involved are much larger as compared with the engineers' vocation. It is amusing for me sometimes to hear from a top level man the virtues of honesty when he himself had a doubtful reputation. It sounds like

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I can speak for many hours on this and the subject of contracting but I hope the above will be enough for this occasion.

Due to the length of my Address, I have not touched upon the very important question of Housing in the Fourth Five Year Plan.

It is a fashion amongst the Presidents of the Institution, in trying to out-do his predecessors, to form all kinds of committees — both practical and non-practical — on various matters as soon as he occupies the 'throne'. I have noticed that so many of them were just born and died as soon as or before his term of office terminated. My submission is, Ladies and Gentlemen, that the President should take care that his enthusiasm to do something spectacular should not become an object of ridicule for the Institution. I do not propose to compete with them but shall try to consolidate or revive many of the useful committees and produce results without any more additions.

The President has the misfortune to receive much unsolicited and free advice as to how the Institution should be run. Many academic or theoretical ideas are given which cannot do much good nor can they be put to practice.

It was amusing to read a few years ago the statement of a non-technical Chief Minister in big headlines that he had to decide whether to save the dam or the capital city; he did not know that if there was no dam, there would have been no capital city!

It is also a fashion with the distinguished guests, both of the State and the Centre, to advise that the Institution should do this and the Institution should do that, though the realisation of many of these ideas lie entirely within the power of execution of these august individuals themselves. The Institution is after all a stone building and ruled by the Council members. It is often not realised by many' of our Council members that any criticism and suggestion apply to themselves and they themselves should come forward to help and put it right.

It is usual with any Association or Institution that the President should make his 'Statement of Policy' when he assumes office. This was not done in the past in our Institution, but I shall take the lead in this matter.

I declare that:

(a) To any problem or duty that the Government or other public bodies may call upon the Institution to advise, the Institution will give its full co-operation.

(b) The Institution will not consider anything more important than making every kind of sacrifice and doing services for the defence of the country.

(c) I declare that I shall guide the Institution wisely but firmly.

(d) I shall help the Students of the Institution, who are the backbone of the Institution and our profession, in all their difficulties. Their cause shall be my cause.

(e) I shall try to visit as many Local and Sub-Centres as possible, if not all, irrespective of my time and expenditure to me, as I do not consider myself too old for this purpose. I feel that such personal contacts with the Centres must be kept by the President.

(f) This Institution will take concrete steps to make our Government discourage non-technical persons from being appointed or given charge of any technical undertaking, where it is the legitimate field of work of the engineers.

(g) For this, the Institution will try and help members seeking election to the Lok Sabha and the Raiya Sabha as far as possible.

(h) The Institution is not the President's personal property and as such I shall serve the Institution not as its master as President, but as its humble servant.

(i) In matters connected with the administration of the Institution, through the Council, I shall not make compromises merely for the sake of peace but shall do whatever is fair and just.

(j) I shall repeatedly impress upon the Council members that all matters should be decided only on the principle that what is good for the Institution should be done.

(k) I shall keep on reminding the Council and all members that they should always consider the Institution bigger than individual, however big and important.

Finally, Ladies and Gentlemen, may I ask you to rise and declare with one voice and assure our distinguished guest that we all engineers will carry the fight on behalf of the nation to the last drop of our blood and carry out any duties that he may call us to perform.

JAI HIND

Maj Gen S P Vohra

President 1967-68

Presidential Address

The Honourable Shri S. K. Patil, Ladies and Gentlemen,

First of all, I would like to thank the Honourable Minister for Railways, Shri S. K. Patil, for agreeing to be the Chief Guest at the inauguration of this 47th Annual Convention of the Institution of Engineers.

Shri Patil heads the Indian Railways which is one of the largest public transport undertakings in the World and, in so doing, has the responsibility for improving among other things, the many-faceted and complex engineering activities of the Railways. He is thus closely associated with and appreciates the responsibilities and problems of the many engineering disciplines in the Railways — civil, mechanical, electrical and telecommunications. Under his able stewardship, the Railways have been able to achieve much to their credit in the engineering field such as laying of high speed tracks, dieselisation and electrification of high density sections, modern i sat ion of signalling equipment, better telecommunication facilities and so on besides the all important improvement in passenger amenities .

Shri Patil's ready acceptance of our invitation to be with us today, amongst engineers, is an indication that he fully appreciates the role, activities and worth of engineers and, particularly, that of the parent body — the Institution of Engineers — in the economic and industrial development of our country. We are indeed grateful to you, Sir, for your close interest in our affairs and for your acknowledgment of the importance and the vital role which the Institution of Engineers has to play, particularly now when our country stands somewhat apprehensive at the cross-roads of its industrial and economic development.

Again, it is a happy coincidence, ladies and gentlemen, that Shri Patil should be with us when the Convention is meeting at Bombay, for Bombay and Shri Patil are, if I may say so, inseparable sweethearts. The city of Bombay, which is probably our best administered city, owes so much to Shri Patil, its Mayor for over a decade, for its pleasing looks, cosmopolitan atmosphere and phenomenal growth. I would like to pay my tribute to the ability and foresight of engineers and administrators who have been and are responsible for planning and maintenance of this great metropolitan city. We are fortunate that many of these engineers are with us today in this Convention.

And now, about this Convention itself, I am immensely proud and conscious of the honour conferred upon me by my brother engineers in electing me to the Presidentship of the Institution of Engineers (India). It is a great distinction indeed, particularly for the military engineers of whom I am one. It is a measure of the regard in which our civilian engineers hold the engineers in the Defence Services. It is a rare privilege and at the same time a great responsibility to be asked to head the Institution at a critical time in our country's economic and industrial health. I am accepting this responsibility with pride and readiness, secure in the knowledge that I shall have the unstinted cooperation and active support of you all, not only to maintain and enhance the fine traditions of this great Institution. but also to bring about further improvements in its organization and technical activities.

It is the custom in our Institution Conventions for the incoming President to talk about his work, responsibilities and problems in the engineering discipline practised by him. It is a healthy convention. It enables others to share his experiences, to learn about the problems encountered in his sphere and how these are being resolved. I shall therefore try and explain to you the responsibilities and problems of the Corps I head, the Corps of Electrical and Mechanical Engineers of the Indian Army — the EME. My reference to this Corps in the Indian Army is also a measure of the importance which Defence has acquired in the recent years due to growing threat of external aggression on our frontiers by two of our neighbours. The strength and prestige of any sovereign nation ultimately depends on as to how well it can defend itself. To produce an efficient and strong military force we must have proper equipment in addition to adequate size of the forces for the purpose. A sound scientific and technological base in the country sustained by scientists, engineers and technologists is necessary to develop and produce the required equipment for the Army. This base must come, in the main from outside the active ranks of the Army — the civilian scientists, engineers and technologists engaged in research, development and production of equipment both in the public and private sectors. Equipment once produced has to be carefully maintained, repaired and kept fit for operational use and this task is performed by the Corps of EME. The task requires efficient and highly trained engineers as I would explain later. The point I wish to emphasize here is that there is an imperative need for close cooperation and understanding between the Corps of EME and all other engineers, scientists and technologists responsible for production of various equipment for the Army. Most of you present here, therefore, are directly or indirectly concerned with the Corps and my reference to the work and problems of the Corps will help in creating better understanding between us.

In the Army, military engineers are grouped under two technical corps — the Corps of Engineers and the Corps of EME. These are two different organisations altogether with quite different tasks. The Corps of Engineers' job is to help the Army to live, to move and to fight. They house the Army in peace and war through the Military Engineering Services (MES) which is a part of them. They help the army to move by constructing roads, bridges, air-fields and by overcoming obstacles. in its path. They help the Army to fight by constructing field fortifications, mine fields and the like.

The Corps of EME also helps the Army to move and to fight, but in a different way by looking after its transport and the entire arsenal of fighting equipment. You may say that the job of the EME is to serve the weapon that serves the soldier—ayudhseva',

Broadly speaking, the role of EME is to promote and maintain high equipment availability for operations and training with minimum cost in manpower and resources. Equipment referred to during the course of my lecture includes all technical equipment belonging to the electronics, electrical and mechanical disciplines. It includes highly sophisticated radar sets, guided missiles, transmission and receiving sets, armoured fighting vehicles, load carrying transport, earthmoving and road building equipment, small arms like rifles, giant long range guns and host of other technical equipment which goes to make a modern Army.

The task of EME starts either from procurement stage if an equipment already in production is purchased, or from development stage if a new equipment is under development. During the development stage, the Corps has to feed the designers information and advise in preferred methods of maintenance and repair in the field, the results of operational experience, etc. In turn it has to extract from the designers the training implications of new techniques, information for training and workshop manuals, test equipment and special tools requirements. Once the equipment is in service, the Corps has two main functions. Firstly, it has to ensure high availability and to return damaged equipment to battle worthiness in minimum time. This requirement necessitates field repair workshops near to the point of failure for repairs and base workshops for overhaul and heavy repairs in rear base areas. Secondly, the Corps has to' ensure that the incidence of failure of technical equipment is kept to the minimum in operational use. This is taken care of by frequent inspection of equipments for serviceability and analysing common defects and. carrying out remedial action. I will deal with various facets of these activities later but at present I like to emphasize the complex problems which all these duties involve. There has to be a proper organization to deal with these problems. To man such an organization by suitably trained officers and men requires a colossal effort. To add to all these problems the fast changing development in technology resulting in new equipments for the armed forces requires constant training of technical personnel. I will endeavour to tell you during the next few minutes briefly as to how we have met some of these problems.

Now, before I go any further I would like to briefly delve into the past and tell you the development of the Corps in its present form.

With little or no equipment present there should not be any need of EME and so the evolution of the Corps is really the story of the mechanization and 'equipmentisation' of the Indian Army over the years. Ever since warriors learned to wield the spear and the sword or fight from a chariot, the need for men to mend or sharpen these weapons arose. But evidently these men were not organised to function close to the battlefield, otherwise why should the redoubtable Karna falter, on finding his *rath* breaking down, and go down before Arjuna? An EME chariot-mechanic, had there been one readily available, could have easily saved the situation for him!

With the development of gunpowder and the appearance of the musket and the cannon, the need for a separate organization specialising in the repair of these weapons was increasingly felt. However, its emergence took quite some time, not until the formation of the Ordnance Corps about a hundred and ninety years ago by the British.

First World War brought in the armoured fighting vehicles — more commonly known as the tank in a crude form, the machine gun and the flying machine. Line telephony and the fuller phone, the spark transmitter, the crystal detector, etc., were extensively used for communications, but radio was little used and was mainly confined to the rear areas. Mechanical transport made its appearance in large numbers and some heavy pieces of artillery, e.g., Big Bertha, were also developed. The fate of the house as an instrument of manoeuvre was definitely sealed in the West. But in India even after the First World War the bulk of the transport in the Army remained very 'unmechanical' indeed, based on the camel, the horse and the mule with the odd very unmilitary looking trucks thrown in here and there. Equipment was confined to mostly personal arms and some field guns. Technical maintenance remained in the hands of the user-arms and the supplying services.

In the United Kingdom, during the twenties and the early thirties, the development of the tank, which in 1918 was little better than a cumbersome steel box mounted on tracks, became bogged down in peace time lethargy and British conservatism. The Germans, however, were quick to capitalise on the British invention and forged steadily ahead with its development technically and tactically. However, during the late thirties, the British began to catch up and brought out some improved versions of the tank, i.e., the Matilda and the Valentine. A new quick firing gun and improved versions of the old breach loading field gun began to make appearance as also the heavy complex mechanical fire control computers and power gun laying equipment for coastal artillery. Some more developments in air defence equipment and particularly Radar were well under way which were to have decisive impact on the course of the Second World War. Very little of all these equipment, however, reached the Army in India before the Second World War, except for the induction of a few tanks and armoured cars and some mechanical transport. Plans to modernize and mechanize the Indian Army were drawn up in late thirties and as a first step towards rationalization, the technical maintenance services of the army were reorganized in April 1939 into one organization—the Workshop Branch of the Ordnance Corps.

The outbreak of the Second World War and the early Allied reverses in North Africa coupled with the entry of the U.S.A. into the War triggered off a second equipment revolution in the Allied armies with tremendous spurts in development of new equipment. New tanks such as the Churchill, the American Lee, Grant and the Sherman, the 25 pounder quick firing field gun and the medium 5.5 in. medium gun-howitzer, whole family of new infantry, anti-tank and air defence weapons, improved telecommunication equipment for medium and long range operation, specialist assault and amphibious equipment — all these took the field and considerable quantities of these equipment started arriving in India for the projected reconquest of Burma. India witnessed an unprecedented spectacle of equipment invasion in 1941-43 exceeding in scale, range and sophistication anything ever seen or visualized before. To enable the Army in India to absorb all this complex fighting equipment and to ensure its operational fitness and technical worthiness at all times, the need for a new centralized engineering organization was found imperative and the Corps of EME was formed on May 1, 1943. Such an organization had been formed in the U.K. a few months earlier.

During the Second World War, the EME played a very effective part in the recovery and repair of fighting equipment wherever Indian troops fought. They shared with their comrades-in-arms, the honours gained by the Indian formations in North Africa, Italy, Burma, Malaya and the East Indies. Besides its normal commitments the EME also took on and successfully executed many ad hoc technical commitments including manufacture of small equipment and stores for the United States Navy, Army and the Air Force, the Royal Navy and the Royal Indian Navy and so forth.

After the Second World War, there was a run down of the armed forces in India, but very soon after the attainment of Independence, the Indian Army was back again on active service, this time as an instrument of national security, acting in Kashmir and Hyderabad. It was the EME's ability among other things, of course, to keep the war-worn equipment of the Second World War vintage in fighting trim that helped the Indian Army in those fateful days of 1947 to evict the Pakistani forces and raiders from Kashmir. I can recall to mind one or two episodes wherein the EME with characteristic resourcefulness and technical ingenuity was able to disassemble and despatch by air badly needed field and medium guns in the Poonch and Baramula Sectors in late 1947. Within minutes of the arrival of the Dakotas at the other end, EME went into action to reassemble the guns, under enemy shell fire, and got them ready to smash up the raider concentrations, then besieging Poonch and Baramula. Yet another episode is the literally breath-taking operation against the Pakistani raiders over the 11,000 ft. Zojilla Pass in 1948, to open up the road to Leh. Tanks were stripped of their armaments and turrets to get them post haste across the frail bridges on the road from Jammu to Baltal at the foot of Zojilla. At Baltal, an

EME workshop reassembled the turrets and armament in the tanks and also carried out certain major repairs. All this enabled the tanks to be deployed in a spectacular armoured action against the Pakistanis. More recently, in the 1962 conflict with China, light tanks were flown in a hurry to Leh and Chusul with the aid of modifications. carried out against time by the EME. During the September 1965 conflict with Pakistan, the EME enabled our armoured formations to have maximum availability of Centurion and Sherman tanks for their daily epic tank battles against the superior Pakistani Pattons. EME's battlefield recovery of damaged tanks after sundown and their subsequent almost overnight restoration to battle-worthiness for the morrow's battle proved an important contributory factor for success in the Khem Karan and Phillora operations. Say the concerned infantry and armoured commanders *sotto voce*: 'Our artillery support and the EME backing have enabled us to win the war'.

Again, the EME's prompt technical attention of the fire control radar of air defence units guarding our forward airfields largely contributed to the security of these vital air bases.

Today, without needlessly indulging in statistical descriptions, I can tell you that the EME is perhaps the largest single monolithic complex of engineers and technicians in India. And I am sure our Honourable Minister for Railways here will not mind my saying that it is much larger than anything that the engineering branch of the Indian Railways can ever hope to match!

Having given you an idea of the growth of the Corps over the years, I must now turn to its organization.

I have already mentioned to you that the role of the EME is to promote and maintain high equipment availability to the Army. How this is achieved can be dealt with under three broad headings — firstly, the nature of the equipment, its range, complexity, and usage; secondly, the structure of organization for, their inspection, repair and recovery, and, lastly recruitment, training and proficiency of personnel staffing this organisation.

The Indian Army today despite its very modest make up vis-a-vis the armies of more developed nations like — the U.S.A., the U.K. or the U.S.S.R. uses a vast range and variety of fighting equipment which may broadly be grouped under four main heads or disciplines.

Firstly, mechanical — mainly automotive equipment which consists of cars, load carrying vehicles, armoured fighting vehicles, earthmoving and road building machinery, air conditioners, machine tools, etc.

Secondly, armaments which include small arms like rifles and machine I guns, artillery both light and heavy, anti-tank and anti-aircraft weapons in addition to a host of other equipment like mortars, etc.

Thirdly, fire control and optical instruments like binoculars, telescopes, range finders, dial sights, compasses, theodolites, infra-red equipment, etc.

Fourthly, electronics equipment including communication equipment like telephones, teleprinters, all types of wireless transmitters and receivers, radar sets for early warning, fire control and surveillance purposes, electro-medical equipment and last but not least the guided missiles.

All this is a formidable array of equipment embracing a number of engineering disciplines and techniques. The problems of looking after all this equipment becomes still more difficult as a large quantity of equipment now in service are from different countries following different national standards resulting in formidable difficulties in provision of spares, tools and test equipment. Some of the equipment is of old vintage and already out of production in the country of origin. To maintain such equipment it becomes necessary to manufacture a vast variety of spares in own workshops — sometimes even at comparatively high cost.

I may also mention here some other problems which add to the magnitude of our task. First is the wide dispersal of the equipment all over our country varying in climate and environments having entirely different effects on behaviour of engines and machinery. Consider Ladakh and adjoining areas situated nearly 18,000 ft. high with minimum temperatures of minus 35°F. in winter to arid desert areas of Rajasthan with 120°F temperature in summer of Assam with very high humidity and temperate climate. In Ladakh touching of steel with bare hands would result in frost bite while in Rajasthan burns! Incidentally we had to develop gloves for use of technicians in cold weather in Ladakh to avoid frost bites while repairing equipment. Consider again the effect of lack of oxygen on internal combustion engines in Ladakh not to say of behaviour of lubricants, etc.

Second aspect which I would like to mention is that equipment in the Army at any place at anyone time is mixed. For example an artillery regiment in the army will have mechanical transport to move guns and small arms to fire, optical instruments to direct fire and telecommunication equipment for communication between different sub units. This mixture of equipment, as you would appreciate, raises enormous problems for their maintenance and repair—not to talk of supply of spares in adequate quantities.

The third problem which I would like to emphasize is that the equipment is generally used in areas far away from the base where either equipment or its spares or other facilities for overhaul are normally available. It is often not possible either to get a replacement in time or to back-load the equipment to base for major repairs or overhauls. I will revert to this point while discussing the repair organization in the Corps a little later.

Now the tasks and how we meet them. I will first deal with advice to the research, development, procuring and user departments and arms. As mentioned earlier, we keep in close touch with the research and development organization. During development of an equipment we feed them with information and advice in preferred methods of maintenance and repair in the field, the result of operational experience etc. and in turn we extract from them the training implications of new techniques, information for technical and training manuals, test equipment and special tools requirement. We also associate with them for user trials to gather information on defect proneness of the equipment in order to have proper assessment of spares required for maintenance and overhaul during the first 2-3 years of the usage of the equipment. Incidentally forecast of spares required for maintenance and overhaul is a complicated and important function. Excess provision of spares locks up valuable money while inadequate provision may result in an equipment being out of service when it is urgently required in the battlefield. Consumption of spares on the other hand depends not only on design features and quality of material used but also on the extent of usage, climate and the terrain in which an equipment is used. Preparation of scales of spares required is a vast subject and I do not intend to go deep into it here. We have an organization known as the Technical Group EME which in addition to preparing scales of spares deals with other technical matters like investigation of common defects, preparation of modification instructions found necessary after introduction of an equipment into service, preparing technical and workshop manuals, inspection standards etc. of all equipment accepted in service. This organisation also collects feed back of technical and statistical data from the field on equipment performance which enables us after due processing and analysis to derive decision aiding information concerning preventive replacements, periodicity of checks and overhauls, areas of design improvement, areas of special training or repair attention etc. To advise user units on technical problems and coordinate working of all EME units in an area, we have EME staff officers in the Headquarters of all formations.

Our next task is inspection. Inspection in the Army is as important as in any industry. But unlike in industry, where inspections are concentrated in the factory, for army equipment a wider inspection network is needed which can deal with all natures of equipment whatever their status and location. For example, a periodic inspection of equipment in the hands of troops ensures that the equipment is used sensibly, user preventive maintenance is carried out regularly, necessary repairs are carried out in time and that there are no inherent design or manufacturing defects present or suspected. Inspection of equipment in reserve stored in depots, is also carried out to make sure that the equipment does not deteriorate in storage and that before issue to troops it is in 'fighting fit' condition. Then there is the inspection of the output from various EME workshops to ensure that repair and overhaul is sound, complete and in accordance with standards. The inspection set-up in the base workshops bears a close resemblance to the quality control organization in a modern factory. Inspections of equipment used by troops in varying environmental conditions of terrain and climate and those carried out on equipment in storage do bring to light various weaknesses or defects in design, manufacture or material. These are rectified, after due investigation, in the form of modifications to equipment as mentioned earlier. Such instructions are also issued by the Technical Group mentioned earlier.

Now I come to our major role of repair and overhaul of equipment. Our aim in organising repairs is to return a damaged equipment to battle worthiness in the minimum time. This requires repairs to be carried out adjacent to the point of failure. If we could provide facilities for all types of repairs there, then the matter would have been simple but this is not possible. I would like to make two points here before I go further. First, the war of today is not fought in static lines and decision, of victory and defeat are not arrived at in a single battle as in old days. Mobility is the essence of army's ability to fight and troops and equipment may have to move hundreds and thousands of miles in a long drawn war. Secondly, warlike equipment like tanks, vehicles, guns, wireless sets are found right with the front troops and points of failure of equipment may be right under the enemy fire. I have mentioned these points to emphasize that mobility and time must be given high degree of consideration in evolving any system or organisation for repairs.

We have, therefore, conflicting requirements of repair organization from technical and military points of view. From technical point of view we would like to have large static installations with suitable accommodation where work could be carried on in planned and steady flow system with specialist machinery. Military considerations require a mobile flexible organization capable of working in the open in improvised shelters with limited facilities. The organization should also be capable of quick deployment splitting into small groups, if necessary, to carry out repairs as near to the point of failure as possible to reduce time an equipment is out of service.

In evolving an organization for repairs proper balance has to be kept between the requirements of engineering efficiency with military requirements. This is-achieved in the Corps by having four echelons of repair. First echelon is called light repairs, the second and third field repairs and the fourth base repairs.

Light repair units are generally called 'Light Aid Detachments' (LAD). This is the first tier of EME support. Each major mechanized unit of the fighting arms such as armour, artillery and signals, has attached to it an EME Light Aid Detachment, which varies in strength upto a maximum of 1 officer and some 90 technicians. These LADs are mobile and keep peace with their parent units. They have hand tools, special maintenance tools and in larger detachments welding and battery charging facilities and mobile (vehicle borne) workshop facilities. Their role is to undertake quick repair which can be effected without loss of mobility and their organisation is based largely on military considerations. They can change sub-assemblies and do small manufacturing jobs and on occasion they may even change major assemblies such as engines and transmission units of vehicles and tanks. Light and quick repairs to armaments and electronic equipment are also undertaken.

Field repair workshops represent the second and third tier of EME support and are known as second and third line workshops. The workshops are equipped with powered machinery which includes a fair sprinkling of specialised machinery, a wide range of tools, gauges and test equipment as well as hoisting and handling equipment and portable workshop shelters. Second line workshops are mobile and can be sited fairly close to concentrations of fighting equipment in the hands of troops that they support. The strength ranges from 6 to 7 officers and 250 to 400 combatant technicians in each workshop company. A brigade group or equivalent is assigned such a workshop which can handle a wide range of equipment. Specialist vehicle borne workshop and repair equipment are provided for repairing tanks, MT, weapons, guns, instruments and electronic equipment including radar. The workshops can provide mobile repair teams to go well forward to deal with damaged tanks and other important heavy equipment such as guns and tractors, which cannot be easily brought back to the main workshop site without undue effort or loss of time. The moral scope of these workshops comprises repairs to major assemblies and systems, replacement of major assemblies, recoil systems of guns, alignment, specification testing and calibration of electronic equipment and so on. Manufacture of spares and parts is also undertaken. All this type of work calls for a measure of stability and the second line field repair workshops are afforded every chance compatible with the military situation to stay put for reasonably long periods. The third line workshops are much bigger than the second line workshops and they are semi-mobile with a greater range of specialised machinery like cylinder honing and crankshaft grinding equipment, and other machine tools for the overhaul of selected major assemblies. These workshops are in support of second line workshops of the divisions and in fluid military situations accept the overflow of work from the latter to keep them mobile and free for operating with their parent formations.

Lastly, there are base repair workshops which are also known as 4th line workshops. In these workshops heavy repairs including complete strip and rebuild of equipment or selected overhaul are undertaken under static conditions similar to a factory or a large reconditioning railway or transport workshop. Here engineering, rather than military considerations, dominate except perhaps for certain repair priorities imposed by the General Staff as dictated by the overall operational requirements. These workshops are provided with suitably designed technical accommodation and other facilities, a wide range of general purpose and specialist machinery, overhead cranage and material handling equipment and skilled civilian labour with scope for carrying out full scale manufacture of not only spare parts and components incidental to repair but also certain complete stores such as trailers and vehicles bodies. A modern and well equipped tool room for the manufacture of special tools, jigs and fixtures is also provided, besides a well equipped laboratory with chemical and metallurgical testing facilities. There is full scope in these workshops for application of modern engineering methods and management techniques. Although these workshops function as full blown industrial units, it must be appreciated that these are very much complementary to the rest of the repair organisation and serve as a vital link of the integrated repair chain in the field. There is also a modified type of the Base Workshop known as Advance Base Workshop which carries out similar role in forward areas, with a view to trapping as many unserviceable equipment and assemblies needing overhaul as far forward as possible to ease the logistical burden of rearward evacuation.

As an adjunct to repair the EME has a recovery organisation equipped with wide range of recovery vehicles — wreckers, including armoured recovery vehicles, tractors and trailors to extricate, recover and evacuate tanks, vehicles, guns and other heavy equipment that have become damaged, ditched or bogged. The job of recovery organisation is to search and recover from the battlefield and other areas all equipment casualties to the nearest EME workshops or specified equipment collecting posts for further backloading rearwards for eventual repairs and overhaul in rear areas. The ability and boldness of the EME in recovering tank casualties, even while a battle is going on, to workshops for speedy repairs and restoration to operational fitness, is generally a major battle winning factor in tank battles.

Having dealt with the organization of the Corps, I now, come to personnel. Our personnel both officers and men have to be good in both professional and military duties, as they have to work in forward areas and are required to defend themselves in battle. The training of nearly 3,000 technical officers and many thousands of technicians is a task of great magnitude for which we have two very well equipped schools and three training centres.

Let me take the training of technicians first. A technician must be a resourceful and versatile craftsman, fully trained in one of the 24 basic engineering trades of the Corps. He must have an adventurous outlook and be absolutely fit mentally and physically to be able to respond to the challenge of the raw and the wild and the little known. Besides being a technician, he must also be a soldier trained to play his part as a disciplined combatant Frankly, I have to admit that although there is no dearth of the type of men that I have described in our country, the Corps is somewhat disappointed to see that there is not by any means a rush of such persons to volunteer into the Corps of EME. By this I do not mean that the response to recruitment is not good; in fact, all our annual recruitment programmes are oversubscribed. But we are not finding it easy to get the right man with technical aptitude and scientific attitude of mind. I suppose we are all competing for scarce material all round and the fact that the army cannot match the monetary awards open to such personnel in other walks of life is probably the cause. But then we have more to offer in the way of comradeship, *esprit de corps* and variety which in the ultimate analysis count for more than mere monetary rewards.

Our men come from all over India and the Corps is of multiclass composition. At present we have only the adult entry and young men come to us from towns and villages with educational qualifications ranging from middle school to high school and even P.U.C. They are given military training and then depending on the results of certain psychological trade aptitude tests administered to them, trained in one of the 24 basic trades of the Corps e.g. gun fitter, vehicle mechanic, electrician, radar mechanic and so on. The man is then sent to an EME workshop in the field for on-the-job training after which he takes his legitimate place in the organization. From time to time, as he matures, he attends trade upgrading courses and tests for advancement up the trade proficiency ladder. Every year a general competitive examination is held to select suitable young tradesmen for advance technical training normally up to Diploma standard, and development of supervising qualities, to become what we term armament artificers in the Corps. These men ultimately rise to JCO rank and some of them secure Special List Commission in the Corps.

To improve the quality of supervisory personnel as also to generally stiffen up the technical rank and file of the Corps, we are presently working on a scheme of apprentice entry. The idea is to select young and promising high school or even higher secondary school boys, age group 15 to 17, and give-them intense scientific, military and technical training for three years in a specially staffed and well equipped apprentice school. These boys will emerge as full fledged tradesmen and then be potential armament artificers.

As regards officers, who form the professional grades of the Corps, the job requirement is for a chartered engineer of either the mechanical, electrical or the electronics discipline. I would like to remind you that the EME officer during his career may be called upon to command or work in an EME workshop ranging from Light Aid Detachment of one or two officers and 90 men through a field repair workshop with 7 officers and 250 to 400 men to an army base workshop with about 30 officers and about 2,500 combatant and civilian personnel. He may have to work as a technical adviser and consultant on equipment matters to the commanders and troops in a formation. Or he may, while in the Technical Group, be associated with the design and development of new equipment or writing of technical literature or research in new repair techniques or in preparation of spare parts scales and so on.

The young EME officer has therefore to have a sound Corps oriented engineering training covering practically all disciplines that are associated with fighting equipment so that while commanding a small workshop by himself he is able to cope with a variety of problems. As he matures, he may have to do an advance engineering course which is equipment oriented but with a strong underpinning of conceptual and theoretical knowledge concerning design. As he further matures, he is trained in general and production management which includes work study, materials management, production planning and control, wages administration and factory legislation to be able to serve effectively in the Corps base workshops and the Technical Group. The technically bright and promising officers of the Corps are sent on post-graduate courses to Universities in India and abroad so as to further educate and equip them for design and developmental work in the Corps and outside. Every officer of the Corps, whether he is mechanical or electrical, is taught electronics to be able to exist in the somewhat over-powering and ever thickening atmosphere of electronics in a modern army. Besides, a high percentage of the officers are trained for specialisation in advanced electronics to be able to cope with the ever increasing volume of sophisticated electronic equipment in the army.

The officer entry is via two streams. The NDA-IMA cadet with aptitude for science and mathematics is commissioned into the Corps and he undergoes the Corps oriented three-year army degree engineering course jointly conducted at the College of Military Engineering, Poona, and EME School at Secunderabad. The other stream brings in the University product, a bachelor of engineering in mechanical, electrical or electronic disciplines. They are both treated on par for further training and employment. We have also a scheme under which some of our best NDA-IMA trained officers are sent to Universities for an engineering degree.

You would pardon my indulgence if I say that an officer trained in the EME has very high professional and managerial competence and this is proved by the fact that a large number of our serving and retired officers hold responsible positions in both private and public sector undertakings.

I have so far given you an account of the responsibilities, organization and problems of my Corps. Officers of the Corps of EME by virtue of their training and association with a broad spectrum of engineering activities in relation to the design, development and repair of equipment, are also eminently suited to play an important part in the logistic or equipment management of the army. Presently their employment is largely restricted to the execution of their engineering function although senior staff appointments in the logistical, equipment and administrative departments in higher Headquarters could be given in increasing proportion to suitably qualified EME officers. An occasional representation is there, no doubt, but there are no signs of any definite spread in this direction, Perhaps the reason is the psychological aversion to change prevalent all over.

I find that a somewhat similar situation, but on a distressingly large scale, exists in technical departments of the Government and public sector enterprises. Unfortunately we persist in continuing the system which the .British adopted to administer a dependent colony. The aim of the British was to keep India as a supplier of raw material and market for consumption of their industrial products. The then Government of India while giving patronage to British commercial interests did not itself participate in industrial activities in the country and considered keeping law and order and collection of revenue as its prime function. To carry out these functions, the Government instituted a secretariat system of administration with power and authority concentrated at the top with the elite 'generalist' — Indian Civil Service Officers. The one exception to this system was the Indian Railways, inherited as a package deal from the erstwhile British owned railway companies with enlightened system of management similar to any commercial undertaking. Even in those days the British recognized the advisability of running the railways through Railway Board manned by railwaymen, without imposing intermediate secretariat system, for efficient functioning. One would have thought that with increasing participation of the Government in major industrial undertakings, it would at least administer these not only on the lines of the Railway Board but improve it by instituting a system based on modern management techniques. However, to the dismay of all professional men, the Government is merely transferring its civil servants and introducing outmoded secretariat and financial systems to run the public sector undertakings and technical departments. A return of $1^1/_2$ - 2% per annum only from these undertakings in which we have invested nearly Rs.2,400 crores is an indication of their poor performance under the present system of management.

Modern administrative machinery necessary to develop a welfare state on socialistic pattern of society is a complex undertaking. The deep involvement of the Government in the process of production calls for knowledge, skill, judgment, aptitudes and experience not normally found in traditional civil servants. An analysis of the inefficiencies, delays, increase in expenditure and such other drawbacks in the final results, will indicate that in a large number of cases these shortcomings, are due to diffusion of responsibility resulting from the intermediary of the secretariat and financial system. I consider that the bureaucratic system with its complicated ritualistic code and procedures as prescribed by the civil servants must be changed to enlightened business and management practices followed by professional men in successful commercial undertakings.

In order to elevate the living standards of under-developed countries, it is necessary to raise national income by increase in agriculture and industrial production. This entails firstly proper scientific and technical education, research and development of new methods, techniques and products. Secondly, optimum use of natural and material resources of the country to increase production in various fields. The scientist, the engineer and the technologist is more suited to make significant contribution as compared to the general purpose administrator towards this end. Our present administrative system does not ensure that the scientist, the engineer and the technologist are given positions where they can effectively contribute to the industrial and economic development of the country. It would be appropriate to mention here that in technologically advanced countries like the U.S.S.R., the U.S.A., the U.K. and France, many of the technical departments and planning bodies are headed by engineers and experts and not by generalist administrators. We must, therefore, follow similar pattern in this regard in this country if we are really keen to hasten our progress.

I hope that the Administrative Reforms Commission headed by Shri Morarji Desai would look into this aspect of administration of technical departments and public sector undertakings. The Institution of Engineer (India) has submitted a memorandum to that Commission recommending among other things that the technical personnel be given responsible administrative positions including members of Cabinet at Centre and State Governments dealing with technical and industrial departments. The present system of administration and financial controls should also be reviewed keeping in view the current needs of the country. I am sure that the Administrative Reforms Commission would take note of our recommendations and suggest appropriate action by the Government as I am of the firm opinion that unless scientists, engineers and technologists are given responsibility and with it necessary authority to run these undertakings on commercial basis, there would be no appreciable improvement in our economy. Finally, I have no hesitation in saying that so far as technical departments are concerned, the days of generalist administrators are over and the technocrats have to take over technical departments as early as possible — the earlier the better if a major set back in our economy is to be averted.

I do hope that I have been able to arise your interest in the working and problems of the great Corps of Electrical and Mechanical Engineers and have also succeeded in focussing your attention on burning problem of administration of public sector undertakings and engineering departments. Notwithstanding the recommendations of the Administrative Reforms Commission, much will depend on the way we ourselves perform as engineers and administrators. Our administrative and technical integrity, competence and dedication to developing an industrially prosperous society will be keenly watched by the people and their final verdict will be influenced not by our talk and promises but by actual deeds and results. r have no doubt that we will rise to the occasion.

I now request our Honourable Minister to address the gathering.

JAI HIND

Maj Gen S P Vohra—a Brief Profile

1. General S. P. Vohra was born in the year 1915 and joined Maclagan Engineering College (later Punjab College of Engineering and Technology), Lahore, in 1932. He qualified from there in 1937 after securing 'First Class' first position in the Electrical Group with distinction in Electrical Engineering, Hydraulics and Hydraulic Machinery.

2. He had his practical training in the Central Mechanical and Electrical Workshops of the North Western Railway at Moghalpura (now in West Pakistan). During this period he was associated with the trials on the dieselization of the Lahore-Karachi sector by the Railways in collaboration with Metropolitan Vickers of the U.K.

3. In 1940, Gen. Vohra was commissioned into the Indian Army as an Ordnance Mechanical Engineer and in 1943 on the formation of the Corps of Indian Electrical and Mechanical Engineers (IEME), he was the first Indian officer to be transferred to this new Corps. The early years of his service were in a Mobile Workshop Company and other staff appointments. In 1945, he was specially deputed for study and training in the War Office Selection Board at Cairo for evolving selection tests using modern intelligence, personality and aptitude testing techniques. At the time of the Partition, Col. Vohra, as he was then, was posted to the Military Evacuation Organization to plan and organize workshop set up for the huge fleet of the Army and requisitioned mechanical transport units created for the evacuation of the large number of refugees coming over to India. In addition, he had to regroup and reallocate the Army tradesmen coming from Pakistan to different IEME units in India. In November 1947, he was appointed Deputy Director of Electrical and Mechanical Engineering in H.Q. Delhi and East Punjab Command which was later on reorganized as H.Q. Western Command and was one of the youngest officers to be promoted to the rank of Brigadier.

4. During the period of 1947 to 1953, as a Brigadier Electrical and Mechanical Engineering in Western Command he was responsible for ensuring the battle worthiness of the entire range of the fighting equipment and the large fleet of vehicles employed in Jammu and Kashmir. It is to his credit that during this period the Indian Army achieved quite a few firsts in the Engineering field. Heavy guns were dismantled, flown across to the Kashmir valley, reassembled to provide artillery support within hours of their landing there, thus helping in the driving away of the raiders. Tanks were moved under their own power up to Zojila Pass (about 12,000 ft. high) in the historic link up with Leh. A considerable amount of technical ingenuity and improvization went into the planning and execution of these operations conducted against time and in the most difficult terrain.

5. In 1949, he was detailed on deputation to the U.K. for about a year to study the organization of the Royal Electrical and Mechanical Engineers field workshops and recovery set-up as well as their technical training establishments in both the U.K. and Germany.

6. In 1953, he took over command of the E.M.E. Centre, Jalahali, and moved and established it in its permanent home at Secunderabad incorporating the most modern technical training aids and techniques.

7. In December 1955, Brig. Vohra went again on deputation to the U.K. for study of modern industrial administration, management and production techniques and their application in certain selected civilian industrial undertakings of repute in the Automotive and Electronic Engineering fields as well as in Army Base Workshops of the REME. He also visited the British Army in West Germany to study the organization for heavy repair and overhaul of the modern sophisticated Army equipment in Advanced Base Workshops. On return he was first appointed as Deputy Director at Army Headquarters and later in 1960, promoted to the rank of Major-General to head the Corps of Electrical and Mechanical Engineers (E.M.E.), which appointment he has held since then.

8. During the past six years of his stewardship of the Corps, he has been responsible for vast improvements and reorganization aimed at making this Corps administratively and technically competent to perform its role of keeping the vast variety of the sophisticated combat equipment of the mechanized Indian Army consisting of tanks, guns, wireless and radar equipment, a vast family of Infantry weapons as well as tractors and earthmoving machinery, in 'fighting fit' condition. The reorganization of repair and recovery facilities in the field Army has been carried out to achieve centralized command and control to ensure optimum utilization of technical manpower and *workshop resources without compromising the flexibility required during operations To avoid unnecessary movement, Advance Base Workshops have also been created in the 'forward area' to carry out overhaul of fast-moving Army equipment.*

9. Gen. Vohra has paid particular attention to the technical training in the Corps. To meet growing demands of the Corps, additional training centres have been established on zonal basis. For the officers who are qualified engineers, further training facilities have been created to impart sound knowledge of Army equipment, workshop processes and techniques. Training has also been suitably oriented to help and guide them to develop technical ingenuity and improvization so that they can provide effective technical super vision and direction in their specialized branches of engineering. For this purpose, advanced training on the lines of post-graduate courses in civil institutions are conducted in Automotive, Armament and Instrumentation and Electronics Engineering in two E.M.E. Schools at Baroda and Secunderabad. Regular courses for senior E.M .E. officers are also being conducted in Secunderabad which have been recognized by the All-India Management Association as being equivalent to an advanced course in Industrial Management.

10. He also realized the necessity for a vast engineering corps to be professionally up-to-date in order to perform its various functions effectively. He, therefore, advocated the importance of associating the equipment and the maintenance engineer with the development of new equipment which are being progressively manufactured in the country through its various stages of design, development, prototype production and users' trials so that various aspects of reliability and maintainability could be given due weightage. The Corps has at present close liaison with Engineering Industry and various laboratories and professional institutions in the civil sector.

11. He also foresaw the necessity for the Corps to undertake manufacture of a variety of spares and components not available both from abroad or civil market. To coordinate all this work and to ensure proper planning and optimum utilization of skilled manpower and the technical resources of different base workshops having a large range of plant, machinery and test equipment and employing over 20,000 industrial workers, a Technical Group E.M.E. headed by a Major-General has been created, which has a Chief Production Engineer, a Chief Quality Engineer and three Chief Engineers in the specialized branches of Automotive, Armament and Instrumentation and Electronic Engineering. This Group will enable the Indian Army to have reliable and indigenous combat equipment.

12. Gen. Yohra, being a sportsman himself, has taken a keen interest in the sports activities of the Corps of Electrical and Mechanical Engineers also. He represented the Punjab University in Hockey and was the Captain of the Army Hockey Team which won the Services championship in 1941. He is a keen golf and squash player. It is primarily due to his unfailing interest and encouragement that the Corps has produced such outstanding athletes of international standard as Milkha Singh, Tarlok Singh and B. S. Barua who have won gold medals in Asian and Commonwealth. Games. The Corps has won the Army Rifle Association championship and other shooting competitions for a number of years. The Services Basket Ball team which won the national championship this year had as many as four players from the Corps of Electrical and Mechanical Engineers.

13. General Yohra is a member of the Institution of Mechanical Engineers, London, and of the Institution of Electrical Engineers, London. He has also qualified for the membership of the British Institution of Management by undergoing a Senior Management course in the U.K. He has been a member of the Engineering Faculties of the Punjab and Delhi Universities.

14. He became a member of our Institution in 1957 and has served the Institution as Chairman of the Delhi Centre during 1962-63 and as Chairman of the Mechanical Engineering Division since 1965. He has represented the Institution on the Mechanical Engineering Division of the Indian Standards Institution. He has been elected President of the Institution for the year 1967-68.

Shri K F Antia

President 1968-69

Presidential Address

Today the President for the 48th year of the Institution of Engineers stands before you. He is deeply conscious of the honour and is beholden to the Council, the supreme body of the Institution, and through it, to its vast body of Engineers for placing him at the helm. He also respectfully faces a galaxy of eminent citizens of this rapidly developing industrial city which holds promise of a great future.

This Institution has been honoured by the presence of Honourable Shri Morarji Desai, Deputy Prime Minister, and we are indebted to him for his gesture. It would be witless on my part to chronicle his numerous achievements, and presumptuous to hint at the country's expectations from him.

It is our good fortune that our Annual Convention is being held this year in Ahmedabad, the capital of a rapidly developing state, and with almost a century of industrial history.

It would be in the fitness of things to make a brief reference to the economic and technological situation in our country. People are inclined to be despondent because of the present economic set back. But every venture has its ups and downs and the aims and objects which the nation has set itself to achieve is a magnificent venture, and one full of abundant promise. The chief causes of our present set back are a succession of poor harvests and aggression by neighbours which has necessitated the channelling of vast sums to defence, sums which would have otherwise been used for increasing the prosperity of the Nation. Added to this is a general feeling of frustration due to political, regional and linguistic .squabbles, a deterioration of moral values in certain quarters and incompetence in places. This is the dark side of the picture. The bright side must needs be set down to assess the true position. There is considerable evidence of solid achievement which one cannot ignore and should not belittle. There is no dearth of talent in the country and the spirit of dedication is very much in evidence. The engineer, conscious of his responsibility, contributes constructively to India's progress and as Pandit Nehru has said, the future of the country will depend more on engineers rather than on administrators.

ENGINEERING DEVELOPMENT AND RESEARCH

Engineering is in a constant state of evolution. The tempo of progress has increased in recent years to such an extent that it is being popularly called a 'technological explosion.'

Spectacular developments such as atomic energy, electronics, space research, satellites, a tryst with the moon, are being achieved at an ever increasing pace. Simultaneously numerous other discoveries and technical advances with far reaching consequences such as automation, computers, etc. are taking place which are not as much in the public eye. For example, whilst sustained nuclear chain reaction was achieved 25 years ago in an elementary form, nuclear power stations with efficacy 3 million times that of coal have already come into existence, and the time is not far off when atomic energy will be used on a mass scale in propulsion of ships and railway trains, in blasting of ship canals through large land masses and in replacement of most other sources of energy.

If India is to benefit from this technological upsurge and to develop into a modern industrial state, we should be able to keep pace with the major changes brought about by engineers and scientists. This can be achieved only if all technical ministries and development departments both at the Centre and in the State are handled by engineers and technologists as is being done with stupendous success in USSR.

A further requirement is for our industrialists to become research and development minded. The amount spent by industries on these essential modern necessities is unfortunately so negligible as to appear almost ridiculous. In USA 10 to 15 percent of the engineering staff of large establishments is allocated to research and development. It would be difficult to find even a handful of such organisations in India.

The amount allocated to research in the public sector in the Third Five-Year Plan was an average of Rs. 290 million per year while the US budget for 1968 provides Rs. 1,70,000 million for research. Perhaps a more equitable comparison would be the percentage of national income allocated to research, the figures for which are: India 0.3 percent and USA 2.7 percent with a vastly higher national income.

It is also pertinent to appreciate that scientific effort doubles itself every 15 years in Europe, every 10 years in USA, every 7 years in USSR and (a disconcerting realisation) every 5 years in China. Another disturbing fact is that whilst India uses less than 1 percent of her defence budget on research, China spends as much as 20 percent of her defence allotment for this purpose. We must realise how rapidly India is being outstripped by its powerful and unpredictable neighbour.

Research in India even in its limited application does not appear to have made any worthwhile impact on the development and economy of the country except in the case of atomic energy. One may well ask for the cause of this lacuna. Research is the spearhead of evolution but it is not an end in itself. The engineer has to make the results of research realistic and applicable to human needs by moulding the scientific aspects to production requirements and achieving economic viability. The first step in this direction is a pilot plant and no research project should be considered as completed until it is processed through a pilot plant for large scale production and is finally subjected to commercial exploitation. This surely is not beyond the capacity of our engineers and industrialists. An outstanding example is that of the Uranium extraction plant at

Jadugoda in Bihar which was built after extensive pilot plant tests at Trombay .

It is advisable to follow through any promising results of research by determining forthwith the method of its application and arranging the agency which could exploit it. It is claimed that if all the scientific techniques available with our agricultural scientists were put to practical use, the country would have no food problem. It would appear essential in the interests of the country to ensure the use of these techniques.

CONSULTANCY

With the vast technological development of recent times, design, construction, processes and products have become so sophisticated that it is difficult to achieve optimum results without recourse to the expert guidance of consulting engineers.

A consulting engineer is one who, by virtue of his knowledge, training and experience in diverse fields, is in a position to render advice on the suitability, soundness and economic feasibility of any scheme. He undertakes the technical responsibility of implementing a project and of producing efficient and economic results. His role is primarily advisory and impartial in nature. His talents can be used with advantage by the entrepreneur not only during the process of evolving a project but also during the entire period of its execution and subsequent working.

Consulting engineers make a substantial contribution to the development of a country. The outstanding success of American industry is in no small measure due to such service. The necessity of such service in developing countries is even greater for utilising available resources applying new techniques and processes, developed both here and abroad, the latter to suit local requirements. He not only brings a fresh and objective outlook on a project but also the specialist's experience on Its various facets. He has at his command a wealth of information on pertinent technical matters and his collaboration results in tapping this information. By judiciously grouping the manufacturing processes and equipment from different sources, he not only makes the best selection but also harmonises the performance of each unit to obtain optimum results.

Indigenous consulting engineer service hardly existed in India before Independence as development and industrialisation was slow and all consulting work was entrusted to foreigners. With the increasing industrial tempo after Independence and the Five-Year Plans, the necessity of organisations for determining the economic feasibility of schemes, for design and for engineering of projects in various fields, particularly industrial, has increased considerably. The challenge has been taken up by engineers with foresight, enterprise and courage and the nucleus of such a service has been well established. Unfortunately encouragement by the government is inadequate and slow. For example, a committee on consulting engineer service headed by the late Mr. S. G. Barve has yet to submit a report on its investigations.

In addition, the absolute necessity for consulting engineer service is not yet fully appreciated in our country and some entrepreneurs are inclined to consider it a luxury. Its need is often recognised only as a result of incurring substantial infructuous expenditure. Yet again, because of the comparatively recent development of consulting engineer service in the country, the tendency has been, and still is, to import foreign know-how. Undoubtedly the country gains by importing sophisticated know-how, not indigenously available. But there are instances where obsolete equipment and processes have been unwittingly imported when equal and even better material is indigenously available. One very recent illustration will suffice. Though Indian engineers are considered to be some of the most advanced, experienced and competent bridge designers and builders in the world, it is amazing to find foreign talent being imported to render advice on the selection of bridge sites.

The urge for foreign package deals is even greater as such an arrangement not only covers the technical know-how but also the economic implications, operation, management and manpower of a project and relieves the sponsors of almost all responsibility. With the availability of the Indian consulting engineer, such package deals for which the country has to pay heavily can only be termed iniquitous. The amount spent so far on royalty and on foreign personnel is a staggering figure of Rs. 1,300 million as given in the Mudaliar Committee Report. It is also perhaps not appreciated that there are greater possibilities of Indian engineers adopting processes suited to Indian conditions and of modifying foreign processes to give optimum results under Indian conditions. The preparation of specifications for plant and machinery would also be oriented to the equipment available indigenously resulting in increased use of Indian manufacture.

It is however important to be clear in our concept of consulting engineer service. One of the essential requirements is that the consulting engineer should in no way be associated with the supply of equipment or with contracts for construction so that his services are unbiased and entirely in the interests of his client. Technical sales organisations of manufacturers, which render useful service in their own fields, should also not be confused with consulting engineer service.

TECHNICAL EDUCATION AND LANGUAGE

The student population has increased in India from 25 million in 1950-51 to about 75 million. This phenomenal growth is reflected also in technical education. The quality however appears to have deteriorated in inverse proportion to the increase in quantity. The Education Commission in its Report has recommended that the emphasis in the coming years should be on quality rather than quantity. The aim of education is not merely to impart information but specifically to build character. Even in technical education it is necessary to find an honoured place for social sciences and to inculcate a sense of moral values. Alas, this fundamental requirement often appears to be overlooked.

Education has also become the victim of the language controversy and we appear to be bogged down in the linguistic marsh. Emotion often becomes the governing factor in resolving divergent views; examples are sited from other countries which are invariably inapplicable and everyone is dissatisfied and unhappy. It has to be conceded that instruction in the mother tongue is appropriate and does not tax the absorptive capacity of the student. It has also to be equally appreciated that a child can take within its stride study of more than one language. There are 15 recognised regional languages and many more variations. If engineering education was to be imparted in regional languages, engineers could only function in their particular region. Mobility would be lost and the country would be placed at a colossal disadvantage. A common language for engineering is therefore an inescapable necessity. It is also strongly felt that in order to benefit from the wealth of technical literature available in the English language, to communicate freely on technical matters with the major part of the world, to derive the benefits of the very rapid technical advances in the world and above all to avoid the danger of lapsing into obsolescence, English should continue to be the medium of instruction for the study of Engineering. A resolution to this effect was unanimously passed by the Institution at one of its recent Council Meetings where it was also specified that regional languages may be used in polytechnics but with the proviso that English should also be taught at these institutions as a compulsory subject. This appears to be a realistic approach if we do not wish to regress in national development.

TRANSPORT

Transport is a vital factor in the development of the country. The rate at which transport facilities are provided determines the pace at which development in industry and in agriculture takes place and the extent to which transport facilities are utilised is a measure of the progress achieved.

The Indian Railways organisation is the largest public sector undertaking in the country and one of which the nation can be justifiably proud. It is the second largest rail way system m the world under one organisation. It has a route length of nearly 59,000 kilometres and gives employment to one and a quarter million citizens. The growth of railway traffic has been phenomenal and it is to the credit of the railways that they have kept pace with the rapid industrialisation of the country. Goods traffic has increased by 200 percent since 1847 whilst passenger traffic has risen by 50 percent. The achievement has been made possible by investing very large sums in the undertaking. Over 20 percent of the total outlay on the public sector' in all the Five-Year Plans have been allocated to railways. This is the bright side of the picture.

There are however many problems which the railways have yet to solve. One such problem is that of working expenses increasing at a much higher rate than earnings. The operating ratio which was 67 percent about 30 years ago has risen to over 79 percent. With the considerable increase in traffic, the tendency should have been for this ratio to drop. Perhaps a significant militating factor is the rise in wages which have increased by 400 per cent whilst the personnel has increased by a little over 50 percent only. Obviously increase in productivity has not kept pace with rise in wages.

Another significant item is the overall speed of trains which remains the same as it was a quarter of a century ago. As any increase in overall speed signifies an almost corresponding increase in carrying capacity and as speeds three times the Indian speeds are being attained regularly in Japan, the necessity for rapid handling and clearance of trains at various stopping places becomes significant.

There are many other major problems but it would be presumptuous on my part, despite having been intimately connected with the working of the railways for many years, to even attempt to list them.

Road transport may justifiably be called 'Cinderella' of the country. I cannot escape this conclusion after close connection with the Indian Roads Congress and the Indian Road Transport Development Association for over 20 years and knowledge of their unending efforts. Taxation in India on road transport is the heaviest in the world.

The country is supposed to have a little over 950,000 km. of roads but as about 70 per cent of these are mere cart tracks, the real road kilometerage should be taken as only 290,000 km. an insignificant figure for a country of the size of India. A road plan had been formulated in Nagpur in 1943 and a second road plan covering 20 years was finalised in Bombay for the period 1961 to 1981. The aim of this plan is to have a network of 51,000 km. Of National highways, 350,000 km. of State highways and District roads and 360,000 km. of Village roads. The estimated cost is Rs. 52,000 million. As the amount invested on roads in the Third Plan was only Rs. 4,450 million it will be a long time before roads adequate for the requirements of the country are available. Even on our National highways there are still over 500 km. of missing links and over 50 unbridged rivers. The production of transport vehicles is also far short of requirements whilst the cost is exorbitant compared with world prices. It is however significant that in spite of heavy taxation and various handicaps including levies for local and regional gain, road transport has not only survived but has unobtrusively gained strength.

In road development lies an indirect aid to solving our food problem. Roads may be built in selected areas with large agricultural potential to connect every village with the nearest market and encouragement may be given to road transport by concessions in taxation to transport operators. A research study carried out in Africa showed that in areas where the road mileage was doubled, the cash crops increased five times.

Toll bridges are not uncommon in other countries and such bridges should be encouraged on National and State highways as this will enable bridges to be built by private enterprise particularly when adequate funds in the public sector are not available. The toll is not likely to be as severe a burden as road taxes as it will be paid by only those who make use of the facility. The provision of toll expressways may also be considered particularly for long distance traffic between important industrial and commercial centres.

The mobilisation and use of country craft for coastal transport is considered important not only in relieving transport by rail and road but also in providing a lucrative means of livelihood to the coastal population. A recent development in water transport is 'hydrofoil speed boats'. They are being used in Britain and in USSR and are capable of attaining a speed of over 30 knots in 15 seconds of the start. Their application for inland as well as coastal transport such as at Calcutta and Bombay respectively would appear to be advantageous.

Another significant development with considerable potential in areas devoid of roads is the Hovercraft which does not require any specific track but moves a few centimeters above the surface, be it land or water. A hovercraft commercial service is already in existence in Britain between Southampton and the Isle of Wight. The potentialities appear to be great and should be tried out in roadless tracts and in the border areas.

The progress of a Nation is governed by the advance made by its transport system. Vigorous development of road transport is of greater importance to a developing nation and should be given a high priority in allocation of funds. "We were not a wealthy nation when we began improving our highways" said a Commissioner of US Bureau of Public Roads "but the roads themselves helped us to create a new wealth in business, industry and land values — so it was not our wealth that made our highways. Rather it was our highways that made Our wealth." Significant advance can only be made by formulating and implementing not a Road policy, not a Railway policy but an overall Transport policy. Unfortunately road and rail transport continue to be dealt with in separate compartments even at the highest level, namely in the Union Ministries. The Neogy Committee on Transport Policy and Coordination has issued its report some time ago and need for early implementation is imperative.

THE ENGINEER AND THE INSTITUTION

With the recent unprecedented advance in engineering the boundaries of the former disciplines and divisions are beginning to be blurred. An engineer concerned with one discipline finds that he has at least to be acquainted with some of the fundamentals of other disciplines if he is to function effectively. The Institution of Engineers (India), because of the foresight of its founders, finds itself in the fortunate position of catering to modern engineering needs as unlike other Institutions, both in India and abroad, it covers various disciplines of engineering such as Civil, Mechanical, Electrical, Chemical, Metallurgy, Electronics, and provides a common platform for engineers in diverse fields. The necessity for such a common platform has been felt in all parts of the world and has resulted recently in the formation of bodies such as the Council of Engineering Institutions in Britain and the Engineers Joint Council in USA.

One may well seek justification for such an Institution. The Institution is essential for the development of the engineer. It provides him with considerable strength and encouragement, howsoever intangible, gives him status and at the same time makes him realise his responsibility as a member of the profession of engineering with a distinct Code of Ethics. Moreover the Institution provides a sound means of keeping abreast of rapid technical developments and a forum for exchange of views. No progressive engineer can afford to presume that he has completed his technical education when he completes his university course without the danger of his knowledge becoming obsolete in a brief period. The Institution,' through its technical papers, discussions, symposia, congress and seminars provides continuing education. Moreover contact with brother engineers from different disciplines broadens one's outlook and perception. The Institution also provides an opportunity, through its examinations, of acquiring an engineering background by those who have not had the benefit of university training.

The Institution continues to move with the times, diversifies and intensifies its activities through its 39 regional centres and subcentres. It practises autonomy in technical matters, each discipline managing its own affairs but exercises coalescence in all other matters. Reforms in the Institution have been a continuing process and are an indication of its vitality. The following further innovations are suggested as they are likely to be of advantage.

For diffusion of information on engineering development to the citizen in general and to government officials, industrialists and businessmen in particular, the time is opportune for this Institution to introduce popular lectures on engineering subjects and discourses. Every regional centre and subcentre of the Institution needs to be made a base for the diffusion of engineering knowledge for the furtherance of the Nation's progress. Such contacts in addition to imparting technical information will go a long way in overcoming inertia and apathy to innovation.

The Institution forms the largest and the only chartered body of engineers of all disciplines in the country. There are, in addition, a number of other engineering institutions pertaining to particular disciplines. In order to consolidate the position of the engineering fraternity and to represent their point of view from a position of strength, a Forum of Indian Engineering Institutions is desirable. The function of the Forum will be to represent the engineering fraternity on matters affecting their welfare and to ensure that engineers are given a rightful place in the affairs of the country. Each Institution will retain its identity, its independent functions and its technical activities as at present. It is intended to explore this proposal as it is likely to be of considerable benefit not only to all engineers and to the various Institutions, but also to the country.

The original concept of an Institution as a professional guild has undergone transformation and Institutions are looked upon in other countries as centres of knowledge for providing technical guidance to the nation. It is a grave national misfortune that there is lack of appreciation of the fact that this Institution is a repository of technical wisdom, of which Government and other organisations, both in the public and the private sector, might take advantage with benefit to themselves and the country. Our Institution can, given the opportunity, play a significant part in assisting our administrators, and our legislators in helping to solve the numerous technical problems with which they are confronted.

THE ENGINEER AND FACTORS INHIBITING PROGRESS

There is a distinct and urgent need for modification of the existing government administrative set-up vis-a-vis the Engineer. All round progress is bound to be inhibited unless the vital part that engineers and technologists can play is recognised and administration is streamlined accordingly. The status which an engineer enjoyed during the previous regime is being eroded and today the engineer at the district level has to be satisfied with a lower status and smaller emoluments than some of his non-technical colleagues. It may be pertinent to add that formerly engineers On Indian Railways were given a special technical allowance over and above the normal scale of pay from consideration of their technical knowledge. Engineers should be left unfettered to carry out their assignments with full responsibility for achieving results. Above all, subservience of engineers to administrators must be eradicated as it is one of the most potent inhibitors of the overall development of the country.

The establishment of an Indian Service of Engineers is essential in the interests of the country. Proposals have been under consideration for some time but have yet to be finalised. If the best engineering talent is to be recruited for government work. immediate introduction of such a service is an absolute necessity.

It has also to be appreciated that skill for management and administration does not stem from any specific educational background. This ability is acquired through experience and the engineer is very favour ably placed for acquiring this skill throughout his career. It would therefore be in the interests of the country to place technical men at the head of technical and even non-technical undertakings. It is often said that engineers should not be wasted on administrative work. Administration by engineers particularly of technical organisations is not only desirable but essential as only technical men can have a thorough grasp of the requirements of such establishments .

Another factor inhibiting progress and achievement in the public sector is the attitude of some of the audit and accounts authorities. Scrutiny of proposals for expenditure at various stages and audit of all accounts are essential requirements but progress would be expedited if the approach was positive and constructive rather than negative and critical.

In large all-India organisations in the public sector, the movement of technical personnel, particularly in the higher echelons, appears to need greater consideration. In the former railway establishments an engineer, found to have abilities above the average, was posted to various districts or divisions in turn over a number of years, so that in the fulness of time, when he was made the head of the' establishment, he had intimate knowledge of the whole organisation and could therefore function effectively. Today it is not infrequent to find engineers being made responsible for areas with which they have not had even a 'nodding' acquaintance.

International technical organisations are of considerable value for keeping abreast of the latest developments. for adopting the latest methods, for discussing problems, and for making contacts with the foremost authorities in relevant technical fields. International technical contacts are maintained in other countries through technical institutions. In India however many such contacts are maintained through relevant government ministries. It is considered that such work lies within the aegis of technical bodies such as this Institution and nominations of delegates to International conferences should be advantageously left to such institutions.

A further inhibiting factor against rapid development of indigenous talent is the state of technical publishing business. The cost of publication has become so high that most of the indigenously produced technical books are beyond the means of those for whom they are meant. On the other hand, technical books by foreign authors are available in cheap subsidised editions. This in itself is very laudable but it militates against the furtherance of indigenous authorship. In addition, unfortunately, a commercial type of authorship appears to be developing where the author is concerned not so much with the quality of his writing but only the economic gain and in such cases plagiarism is rife. Consideration needs to be given by technical education authorities to the prevailing unhappy conditions in the interests of indigenous technical development. Arrangements, perhaps similar to those of foreign powers, need to be made to encourage worthwhile technical publications.

THE ENGINEER'S ROLE IN THE NATION

Confucius has specified three methods of acquiring wisdom and applying it to life. The easiest and quickest way is by following the findings of others; the hard and slow method is through experience; the way of profound wisdom is through original thinking. Engineers, by combining all these three methods, have arrived at an effective procedure in gaining proficiency. The engineer imbibes knowledge based on discoveries and deductions of eminent engineers and scientists through technical education; attains maturity through experience, and achieves progress and evolution through research. In a developing economy an engineer is constantly faced with situations where he must put forward and finalise new ideas and techniques. One with a forward outlook needs determination to overcome difficulties inherent in new ideas and proposals, and courage even to face adversity. He had also to be capable of making decisions. Without such a trait. the engineer becomes ineffective. But learning, experience and courage are not enough. The *sine qua non* for an engineer is the realisation of true sense of values in his dealings with others. This is embodied by the Institution for practical application in its Code of Ethics. The Code is mandatory on those who have the honour to be members of the Institution and the right to call themselves Chartered Engineers.

An engineer, as defined by the Commonwealth Engineering Society, of which our Institution is a member, is one competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibilty for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending and managing, and in the education of the engineer. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgment and the abilty to supervise the technical and administrative work of others.

Our engineers appear to be living up to these requirements. One encounters their handiwork in every walk of life. They have to produce the sinews of the country's economy, carry the burden of implementation of the nation's Five-Year Plans, supply the means of mobility and of communication of the citizens, provide equipment, tools, structures and services for industry, build shelter for its teeming masses, procure water for its agriculture, power for turning the wheels of industry and defence requirements for the safety of the nation.

They have cheerfully and effectively shouldered the responsibilty but lack the authority to produce spectacular results. They have in three Five Year Plans helped to increase industrial production by 150 percent, doubled the carrying capacity of railways to over 200 million tons, augmented electric energy output fourfold, increased the road kilometerage by 80 percent, andbrought the benefits of irrigation to 20 million hectares of land. There is however much headway yet to be made before a self-generating economy is established in the country.

The technological explosion since the Commonwealth Society's declaration in 1954 requires engineers with even greater creative power and capacity for leadership. The engineer has now not only to be in the forefront for advancing knowledge and gradually but infallibly to change the way of life, but to lead and direct the country and command its respect. A turning point in the prosperity and advancement of the nation will be reached when enlightened statesmen realise the potential that lies dormant amongst Indian engineers, a potential which would make our country one of the greatest in the comity of nations.

Dwelling on immediate national requirements, the services of the engineer in general and the Institution in particular may with advantage be utilised in export promotion, proliferation of consultancy service broad, manning of public sector plants, and in the formulation of policy on technical matters.

Mr. M. C. Chagla, when Education Minister, exhorted engineers at the Institution's Convention at Lucknow in 1965 to attain Technological Swaraj. The Congress manifesto at the last election stated: "The men of science and technology will be kingpins of the economic and social transformation of India".

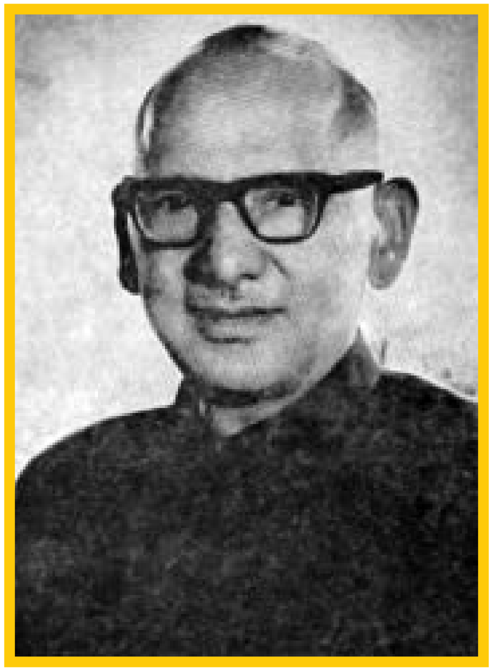
Alas there is a yawning gulf between pious statements and stark realities. Although engineers have been considered to be indispensable in the country's economy and social uplift, they have hardly any voice in policy making. It would be of considerable consequence to the nation if the Institution was given representation in the Lok Sabha, the Rajya Sabha and all the State Assemblies. The Institution has autonomous regional centres in each state and the technical interest of the state will be well looked after by the Institution's representatives. There are engineers who have retired from active technical life whose knowledge and mature wisdom could be profitably utilised. Engineers however do not have the finance, and should preferably have no party affiliations, with which to enter election campaigns and it would be in the fitness of things if they were provided with nominated seats. It is needless to point out that the engineering wisdom concentrated in a body representing nearly 60,000 engineers and the views of its representatives, mellowed by years of technical experience and with a galaxy of technical talent in the Institution to back them, could not but be highly beneficial to the country. Engineers Dr. A. N. Khosla, Governor of Orissa, Dr. K. L. Rao, Irrigation Minister, and Dr. T. Sen, Education Minster, all past Presidents of this Institution, not to mention the famous Engineer-Statesman Sir Mokshagundarn Visvesvaraya, have rendered yeoman service. We feel strongly that the pace of progress of the country would be considerably enhanced if engineers in large numbers are associated with policy -, making of the nation, a step which has been instrumental in bringing USSR to the apex in the comity of nations. Only good can come out of such a move of associating engineers in large numbers in the Ministries as well as the Parliament, a benefit to the nation out of all proportion to the consideration given to, nay a conferment of their right, to the engineers.

The country will be on its way to Technical Swaraj only when all those who are intimately connected with the welfare and the development of the country attune themselves psychologically to the acceptance and appreciation of indigenous engineering talent and welcome their collaboration in policy matters.

Indian engineers with courage and vision, in spite of the present vicissitudes, should prepare for the day of opportunity and recognition. They must realise that "they are the salt of the earth" and owe it to their country to ensure that the salt does not loose its savour. They must aim at achieving the basic objectives of our plans namely elimination of poverty, raising the standard of living, economic and social uplift, provision of gainful employment for the masses and the establishment of a self-sustaining economy. They will achieve these objectives if they adjust themselves to the following attitude which a poet has so eloquently eulogised:

If you can dream and not make dreams your master
If you can think and not make thoughts your aim
If you can meet with triumph and disaster
And treat these two impostors just the same
Your's is the earth and everything that's in it
And what is more, you'll be a man, my son.

Fellow engineers, I wish you good fortune.



Shri T R Gupta

B.Sc. (Engg.), M.I.P.E. (London), M.I.E. (India)

President 1969-70

Presidential Address

SHRI HANUMANTHAIYA, FELLOW MEMBERS, LADIES AND GENTLEMEN,

Before I begin my address I would like to refer, with deep regret, to the sad demise of Shri K. F. Antia after only a few months of his taking over as the President of the Institution. He was an eminent Engineer with alround experience and the Institution has lost in him a stalwart champion who worked with untiring zeal for its progress. May his soul rest in peace.

Shri B. P. Kapadia, who had taken over the duties of the President after the death of our late President Shri Antia, has carried out the responsibilities most admirably with great zeal and personal sacrifice and thus set an exemplary high standard for his successors. I fail to find words that will adequately express my appreciation of his great contribution to the Institution.

Sir

I would like to thank you for agreeing to be the Chief Guest at the inauguration of the 49th Convention of the Institution of Engineers (India).

As a political leader with sagacity and foresight you have gained widespread admiration. Sir, when you took over as the first Chief Minister of Mysore State, you prepared a blue-print for the industrial development of the State with special emphasis on support to technical education, research, and recognition to engineers. Your initial efforts have borne fruit in the shape of ever increasing industrial activity. The city of Bangalore is widely renowned for its extremely modern plants manufacturing planes, earth-movers, railway coaches, electronic instruments, telephones, electrical instruments, electrical motors and switch gears. All these plants are headed by members of our Institution and they have more than justified your confidence.

In your capacity as the Chairman of the Administrative Reforms Commission you have drawn pointed attention to the various weaknesses of he administration and we trust that our recommendations submitted in a memorandum to the Commission have received your due consideration.

I am glad to mention that Shri V.V. Giri, Vice-President of India has written to Shri B.P. Kapadia in connection with the memorandum submitted to the Administrative Reforms Commission saying "it contains some interesting suggestions which I am sure will be considered by the Administrative Reforms Commission. I personally feel Engineers and technical men must be closely associated with the running of our public sector undertakings and so also the technical departments". I appreciate his encouraging remarks and thank him for the same.

Sir, you are aware of the activities of the Institution which has on its roll over 65,500 members and has developed into the largest body corporate. It has its Head Office at Calcutta and 18 Local Centres and 22 Sub-Centres all over the country, with an annual income of Rs. 53,00,000. In its 50 years of existence the Institution has grown to the stature of a premier and the largest composite body of engineers embracing various disciplines such as civil, mechanical, electrical, mining, metallurgy, electronics, telecommunications, railways, public health and others.

Ladies and Gentlemen,

We are indeed happy that our Annual Convention is being held this year in the city of Jaipur which is well known for its layout and architectural beauty. This is also the capital of Rajasthan with a glorious tradition of determination, valour and sacrifice and now is outstanding in all-out efforts to industrialise the region.

Fellow Members, I am deeply conscious of the honour you have conferred on me by electing me the President of the Institution for the year 1969-70. Whatever experience I may have gained as a result of my long association with public and private sector undertakings will be placed at the service of this great Institution.

INDUSTRIAL PROGRESS

Ladies and Gentlemen, Despite recession and many handicaps, errors in economic policies, planning and faulty implementation, set back due to poor crops, delay in commencing the 4th Five-Year Plan, reduction in capital investment both in the private and public sectors, we have already made tremendous progress. This will be clearly established by the statistics of the activity levels or production capacities installed at the beginning of 1952 and at the beginning of 1969, of various industries which have a great bearing on the prosperity of a nation.

Items	1952	1969
Electric power generating capacity installed in million kilowatts	3.0	14.0
Iron & Steel (in million tons)	1.5	8
Coal (in million tons)	50.0	70.0
Aluminium in 1000 tons	15.0	120.0
Machine Tools production approx. in crores of Rupees	2.0	25.0
Total production of engineering goods and services in crores of Rupees	100.0	2,000.0
Goods transported by Railways in million tons approx.	100.0	203 in 1965-66
Cement in million tons	8.0	13.0
Shipping tonnage in million tons	0.5	2.0
Fertilizers in 1000 tons	107 in 1960	967 in 1967

From these figures you will observe that in the past 15 years the country has made outstanding progress in engineering industries, the production having risen from nearly Rs. 100 crores to Rs. 2000 crores per year. Exports of engineering items, from Rs. 5 crores including the steel scrap exported to Japan, are now approaching the target of Rs. 80 crores during the current financial year.

Machine Tools, the manufacture of which was virtually unknown in the 1930s are now produced to a value of Rs, 30 crores per year, with a total installed capacity of Rs, 60 crores. Products include wide varieties of ophisticated and high production machines both designed and built in this country. No country is entirely self-sufficient in the manufacture of machine tools and India too will have to import highly automated special purpose machine tools and equipment. Increased exports should cover the cost of these.

SMALL SCALE INDUSTRIES

The growth of small scale ancillary units has also been remarkable and furthermore these have been specially beneficial for our exports and have brought the cost down and provided employment opportunities. I must say that the Government has done everything in its power to encourage small scale industries.

EXTENDED SCALE OF MANUFACTURE

We manufacture today on a vastly extended scale items ranging from pine, pens and tools to ocean-going vessels, aeroplanes, locomotives, railway coaches, automobiles, high pressure boilers, turbo-alternator sets and an array of industrial machinery and equipment. This has indeed been a major industrial triumph, and has brought about a great potential for the growth of the Indian economy.

INDUSTRIAL REALITIES

We now have established capacity for manufacturing capital equipment and machinery required for the development of basic industries in the country. The establishment of such organizations as Heavy Electricals in Bhopal, Bharat Heavy Electricals in Hardwar, Hyderabad and Trichy, Bharat Earth Movers at Bangalore, Locomotive manufacturing plants and other light and medium electrical and mechanical industries in the public and private sectors has considerably reduced our dependence on foreign countries and checked the drain on valuable foreign exchange.

Sir Henry Hardman, British Secretary for Economic Co-operation, after paying a visit to the 3 plants of H.E.C. at Ranchi aptly remarked that "these plants are the Cathedrals in the firmament of industrial India". In short, these remarks are true expressions of the solid achievement of the country, of which we can all be proud.

TRANSPORT

We have made no mean progress in extending our transport and communication facilities. While just after Independence we had less than one-fourth million shipping tonnage, it has increased to a level of nearly 2 million.

AGRICULTURAL DEVELOPMENT

We have also made a breakthrough in agricultural production. With further concentrated attention on increasing capacity for fertilizer production, small and big irrigation projects, better farm implements an newer varieties of seeds, we will be self-sufficient in food the deficit of which has put considerable strain on our meagre foreign exchange resources and the savings win be better utilized for further industrial development.

RESEARCH LABORATORIES

We have also set up a chain of national research laboratories with modern facilities to develop indigenous know-how, raw materials for import substitution and for improvement of quality and reduction in cost.

CONSULTANCY SERVICES

Consultancy services and design facilities have been built up in the country in recent years, many of our own members having made substantial contributions in this regard.

All these developments have brought us on the industrial map of the world and have considerably improved the living standards of our masses.

The expectations of our people have been much more but "the road to industrial strength and self-sufficiency is a long weary and staggering one and this is particularly so for a developing country like India".

This is the story of our achievements where engineers, scientists and technologists have contributed their share, but they could play a yet more useful role in the techno economic development of the country. More healthy and rapid development can only take place in a climate of confidence and self-reliance where Indian engineers and technologists are provided ample opportunities and scope to assume full responsibility for the designing, engineering and construction of our industrial and other projects and where they have freedom of action to take appropriate decisions without interference or pressure. Both the Government and the private industries have the responsibility to create such a climate in the country which is conducive to growth.

The government which sets the pace of industrial and economic developments, has a special responsibility in this respect. It should set an example to the private sector by creating in the public sector undertakings these very conditions wherein Indian engineers are assured of all freedom to work in the best interests of the country without interference and pressure.

PUBLIC SECTOR UNDERTAKINGS

We have already invested nearly Rs. 4,000/- crores in the public sector undertakings. Due to delays, initial capital investments have become excessive. Most of them are overstaffed and productivity is very low and return on such massive investments are as poor as 1% on an average.

By and large, the technical personnel in the public sector units are comparable to those in the private sector in intelligence, qualifications and integrity. But the public sector technical personnel tends to stale on their jobs as there is neither appreciation for the good work done nor punishment for poor results.

UNFAVOURABLE CLIMATE FOR ENGINEERS

First-class engineers and scientists are frustrated. They get no job satisfaction nor complete sense of participation. Bureaucratic domination, favouritism, managers with no technical background or industrial experience and procedural delays completely demoralize them. As things stand today, unless our public sector undertakings are insulated against the interference from Central and State Governments and from professional politicians, and unless technically competent people who are capable of appreciating the complexities of modern plant are put in charge of them, there can be no real progress.

What is most needed is freedom for initiative and action for the technical personnel. These are very much impeded on account of foreign technical collaboration and turnkey projects. Under these turnkey arrangements, the collaborators assume all responsibility for designing and engineering including civil and structural works. They supervise construction, erection of plant and machinery, all or most of which could be done by our engineers. If Indian engineers are completely neglected and denied opportunities to do creative work and gain experience in our0 n projects they can never develop self-confidence.

EXCESSIVE DEPENDENCE ON FOREIGN KNOW-HOW

Our excessive dependence on foreign turnkey deals and tied aid are also the direct causes of the abnormal delays and high capital cost of many of our projects. The foreign collaboration agreements make impossible any initiative on the part of Indian technicians associated with the projects. If they suggest any new idea or change in designs for procurements of plant and machinery, they are told by the collaborators that in that case they (the collaborators) cannot take any responsibility for performance or quality. This threat is always present not only for engineers, chief executives of the projects but even for the ministries concerned.

I give you an instance of the Foundry Forge Project, Ranchi, where according to the agreement, drawings were to be with the erectors and not to be given to the project authorities. When there was delay in deputing erectors from a third country who supplied equipment on behalf of the collaborators, the work could not be proceeded with, although it could easily have been managed by Indian Engineers. But they were helpless in the absence of erection drawings.

The first stage of the project could have been completed within 2/3 years by conveniently phasing the work and entrusting the responsibility to Indian personnel. Further expansion of the plant could also have been carried out by them with minimum foreign assistance. Thus expenditure of importing nearly 200 foreign experts at an approximate cost of Rs. 2 crores per year could have been eliminated. The plant and equipment cost would have been almost half and many items could have been procured indigenously.

It is obvious that for the overall industrial and technical progress and the healthy development of indigenous engineering expertise, foreign collaboration, whether in the private or public sector, should be restricted to basic industries, highly specialised plant and machinery where Indian know-how is not developed.

UNECONOMIC UNITS

Government's licensing policy has resulted in the establishment of many uneconomic units. Foreign collaborations are frequently sought for only to secure some well-known foreign name or brand. The resultant increase in cost is passed on to the consumer. Numerous examples can be quoted of such misplaced zeal in industrialization. Wire and cable industry, refrigerators, air-conditioner industry, house service meters, electric condensers, electric transformers and motors, cement and sugar machinery manufacturers, cranes and structural fabrication units, machine tools, motor-cycles and scooters are some instances. As a result, overall investment in these industries, both in terms of foreign exchange involvement and internal resources, is 3/4 times more than that necessary.

NECESSITY FOR BOOSTING EXPORTS

After having built a sizeable capacity of the production of engineering capital machinery and consumer goods, it is necessary to import many raw materials either not yet produced in the country or the production of which for a considerable time will not be sufficient to meet the demand. In view of the acute shortage of foreign exchange we have no alternative but to export in a big way. It is obvious that we cannot pay for these essential imports unless we export our engineering products and utilise the maximum installed capacity of our engineering industries. The Central Government has provided various incentives under the export promotion scheme and the industry should take maximum advantage of such benefits.

SCOPE FOR FOREIGN VENTURES ABROAD

Many neighbouring countries are keen to develop their own industries and have joint ventures with Indian entrepreneurs. If we provide technical know-how, set up joint ventures, export plant and machinery, finished or semi-finished components and also various other engineering raw materials, it will enlarge the horizons of our engineers and scientists for creative work and as such we shall be able to export not only machinery and materials, but also skills which will alleviate the problems of unemployment of engineers and technologists to some extent. This is precisely the technique East European countries have adopted to export their plant and machinery to our country. In many respects we are better developed than various East European countries and shall be able to export complete projects on a turnkey basis, which will become a regular source of foreign exchange earnings.

EXPOSURE TO RECESSION

In a way, a light exposure to recession has been beneficial as it has helped many industries to set up quality controls and start research and development activities, as a result of which many of our engineering products are selling on their own merits in foreign markets. Improvements in quality and finish, reduction in cost, in tune with the changing technology is a continuous process and demands constant attention of the engineers and scientists if our products are to become popular in the export markets and maintain their position. Let me tell greater scope for increasing the exports of our expanding production. This will help to reduce our dependence on foreign aid.

UNEMPLOYMENT OF ENGINEERS

During the last two years, the Institution has highlighted the problem and has suggested various measures to the Central Government. I am happy to say that the Government has taken note of our suggestions on this burning question and steps have been taken to rationalize the intake in the technical colleges. Full-fledged Boards of Training have been constituted in different regions. Stipends will be paid for practical training in industries to 8,000 graduate and diploma holders during the current financial year and in the next year the number will be raised to 10,000.

Various public sector undertakings and ministries have been requested to provide more employment and fill up the various vacancies which have been kept in abeyance. Banks and various financial institutions have been given directions to help the engineers to set up co-operatives or their industries on liberal terms.

As a result of this, rural workshops are being set up by Gujarat Finance Corporation and on similar lines co-operatives are being encouraged in other States. The State Governments have also been requested that preference be given to qualified engineers in granting contract work.

Close contacts are being maintained with the State Governments for co-operation in this connection by the Head Office and Centres of the Institution. The response from various employers' organizations and industrial houses, has been very good. They have assured all co-operation in providing training to fresh graduates.

The Institution will further try to establish closer co-operation with the industries in this connection. We expect the co-operation of all for providing training and employment for our fresh graduates. Recession in industry has further highlighted the importance of engineers for marketing and service after sales and as such more and more technical personnel are being recruited by the industry to work as sales engineers. But where these steps are being taken the Planning Commission must once again examine the realistic demand for technical personnel and should lay more stress on quality rather than on quantity of graduates and diploma holders coming out from the technical colleges and polytechnics.

BLENDING THEORY AND PRACTICE

On the one hand arrangements should be made for professors to visit industries during summer vacations to gain understanding of the problems of industries the advancement of production technology and the work being done on designing, research and development and to take up some of the problems of the industries for solution, and on the other hand qualified engineers working in industries should be invited to technical colleges to speak to the students about the shop-floor, problems and illustrate them by examples. The students should not be overburdened by theory. They should be taught to think for themselves and find the solutions to problems and to make use of their hands. It should be compulsory for 4th year and 5th year students to take practical training in industry for 20 to 25 weeks. This sandwiching of theory and practical experience will enable the students to learn the needs of the industries. With this background, students after the final year will be readily accepted by the industries. This approach in technical education will be highly beneficial for the technical institutions, students and the industries. For designing, research and development work, the industry can recruit boys with postgraduate qualifications but for the shop-floor management in industries graduate engineers trained on the basis of the above lines will prove more useful and this will open up better employment opportunities for the graduate engineers.

SELF-EMPLOYMENT OF ENGINEERS

Here I would like to utter a word of caution that in spite of all the steps Government is taking for employment opportunities to engineers and technologists, it may not be possible for a large number of unemployed graduate engineers or fresh graduates coming out of the technical Institutions to find gainful employment. To my mind, self-employment is the real answer.

As I have mentioned a little earlier, banks and finance institutions are providing finance for setting up ancillary units or co-operatives which can take up agencies for farm machinery, implements, electrical wires and fittings, cement, fertilizer, etc. Engineers from various disciplines like civil engineering, electrical and mechanical engineering, agricultural engineering can join hands in such ventures. They can design cheap 2-3 room tenements. They can arrange to set up saw mills for producing woodwork for housing schemes. They can start in different places brick kilns and build houses in the rural areas. They can arrange for sinking tubewells, diesel engine/electrically driven pumps. They can supply materials, tractors, seed, drills, etc. to reach the farmers in the area and can provide repairshops and service. The farmer has sufficient money today. What is needed is confidence amongst them that somebody can help them and they can rely upon him.

The Central Government and the Planning Commission are trying to reduce the size of the 4th Five-Year Plan in view of the poor achievements of the industries and low-utilization of the installed capacity for which I believe responsibility lies on the Government and I have already made a reference to it. Instead of reducing the size of the 4th Plan, the right thing would be to learn from our past mistakes and avoid them in the 4th Plan so that there is better utilization of our resources and thereby we achieve higher productivity, reduction in cost, improvement in quality and more job opportunities.

LIMITING INDUSTRIAL PRODUCTION SUICIDAL

I would like to stress that it will be very harmful for the future interests of our country if we continuously fail to expand our industrial production. For instance it will be highly injurious if the steel target is brought down. Every year through expansion and setting up of new units (steel plants), at least one million ton capacity should be added. This has a great bearing on the overall industrial employment in the country. It will not be correct to say that capital invested on steel per man is employment in the steel plants. We have to take into consideration the equal numbers of personnel employed in coal, limestone and ore mining and transporting of the materials to the plants and finished products to the points of use.

Moreover, the steel produced has to be processed further and the average of 10 tons of fabrication of engineering production per man per year will mean nearly 100,000 industrial employees for converting steel into structures, railway wagons, vehicles, machinery and equipment, etc. You can see the high potentiality of employment and thereby the increasing demand for engineers for steel, mining, transportation, civil engineering and other industries. We have to view the steel production in the country from this angle. Luckily we have sufficient iron ore, coal and the rest of the materials required to produce steel.

Over and above this, we have already installed a very large capacity in our Heavy Engineering Units to produce almost all the plants and equipment required by steel and mining industries. If we do not plan to produce more steel and non-ferrous metals it will mean that the capacity of HEC, MAMC, Structural Fabrication Units, Bhopal Heavy Electricals, Bharat Heavy Electricals, Kota Instrumentations, etc., will remain idle. We shall be incurring heavy losses, on interest and depreciation of our investment, of about 500 to 600 crores of rupees on these plants which will amount to 90 crores of rupees every year and in addition to this, due to under-utilization we shall not be able to meet the running expenditure of these plants and all this taken together will come to one hundred and fifty crores of rupees loss to the Central Exchequer.

At present we are exporting 25 million tons of iron ore. By exporting pig iron we get 4 times higher price and by exporting steel billets, bars and other rolled sections, we get nearly 6 times more foreign exchange. Out of our steel production capacity added year after year, even if we export half the quantity as pig iron, billets, or rolled sections in the next 4th Five-Year Plan, we shall be able to earn Rs. 250 crores foreign exchange which will be more than sufficient to pay for highly sophisticated plants and machinery required from abroad for the additional capacity to be created. In that case we do not have to depend on any foreign aid. There will be a tremendous upturn in the economy of the country resulting in big employment potentiality.

EXAMPLE OF JAPAN

We have before us the example of Japan where, in the past 15 years, the country has made spectacular progress. They were producing 6 million tons of steel in 1952 whereas in 1968 their production was expected to reach the level of 65 million tons. Today, they are the fifth in the world in production of watches; fourth in machine tools; third in steel; second in automobiles, electronics, cameras and petro-chemicals; and first in ships. Japan has much less natural resources compared to ours and if they can make such progress why can't we, and especially having built a very sound industrial base? At one time 'Made in Japan' was considered to denote something cheap and inferior in quality. But today Japan enjoys the reputation of the highest quality in the goods they produce. We must not relent. All our energy should be directed towards harnessing our natural resources and increasing productivity all round. The people must work. Without work we cannot get the good things of life.

REGISTRATION OF ENGINEERS

Our members are very keen about the registration of engineers. The Architects Bill 1968 has already been introduced by the Education Minister in the Rajya Sabha. The Institution will also strive for a similar bill so that the Institution is granted better recognition.

FEDERATION OF TECHNICAL INSTITUTIONS

With the establishment of various technical, professional institutions such as the Institution of Industrial Engineers, Institution of Architects, Institution of Chemical Engineers, Indian Institute of Metals, Institution of Production Engineers and such other sister institutions there is a need to form a Federation of such institutions so that together, their voice in various matters relating to science and technology may be given greater consideration.

In this connection we have to be careful in regard to one point: certain minimum conditions regarding academic qualifications and experience must be satisfied by each institution to qualify it to be a member of the Federation. FICCI is an example of the Federation of Trade and Industry who have a great voice in shaping industrial and economic policies at the Centre. So also by establishing the Federation of Institutions, the engineers, metallurgists and scientists will be better able. To represent their viewpoints in the matters of technical education, research, development and formulation of standards, etc.

MANAGEMENT DEVELOPMENT

In the last decade or so, with the establishment of the National Productivity Council and various other management institutions, considerable training facilities are available in the country for the development of managerial cadre at middle and top levels. Development of managerial cadre is quite a slow process and takes considerable time. I shall endeavour in collaboration With the industries and various management institutes to formulate proposals for selection of engineers, scientists and technologists in the industry, for their Job rotation and management training so that in course of time industries could train their own management cadre. Industrial management training is a necessity.

There is indeed no substitute for good management training which takes into account the proper co-ordination of all the important activities or functions, such as finance, administration, production management, marketing management, materials management, research and personnel administration. With good technical back around and knowledge of the industry and proper management training, scientists and engineers will make the best Industrial Administrators.

DEMOCRACY AND PUBLIC RELATIONS

We, Engineers, conservative by nature, restrained in expression, and precise in our thinking; have yet to realize the full implications or importance of public relations in a democracy. This naturally reflects on the organizational set-up of our Institution. Though it is the premier national organization of engineers-discipline — or subject-wise the most comprehensive (the largest in the world) and revenue — and membership-wise the very largest in India — its paramount importance in all its political and economic implications remains virtually unknown to the Members of Parliament, the Union Government and the public at large. It is high time that we wake up to these realities and strengthen our public relations so as to comprehensively cover industrial employers, the Union and State Governments, and the Press.

Frankly, our conservatism in public relations has only provided fertile ground for so many mushroom organizations who sometimes pretend to talk on behalf of all engineers in India.

It will be my endeavour and, indeed, should be the endeavour of all Chairmen of various Centres and Sub-Centres, to project the image of the Institution through press, platform and personal contacts to the millions of our countrymen.

EXTENSION OF ACTIVITIES

Each and every Centre and Sub-Centre of ours should develop club activities, more constructive than recreational, so as to attract almost all the engineers and the members of their family in their spare time. Today, if every engineer decides to devote half-an-hour a day to his Centre or Sub-Centre, and direct his mind to think, talk and act on matters affecting his profession, self-employment of his junior brethren and, more important than all these, project the service aspect of his profession as developed by the Rotary Club, Lions Club, etc., keeping especially in mind the crying need of our villages to mechanize their farming, you will find that the masses will come forward to give a tremendous response to our services and eventually we could command our way to Parliament rather than demand our way as we seem to do today. There is no short-cut to it except service before self and consistent and organized hard work.

TO OUR STUDENT MEMBERS

More than any other section of our members, recession has hit harder our student members and we all feel for them. I would tell them that recession is not a new phenomenon; many of us have gone through worse times than they are facing now and that too under an unsympathetic foreign domination. In the context of today's fast industrial development in an independent India where we plan on our own, recession, I say, would prove a blessing in disguise. Whether we like it or not, we have to be a bit more hardy so as to stand on our own feet. A good number of today's Chief Engineers have gone through more difficult times and all that I would ask the students to do is to shed their white collar attitude to life and work, and to take whatever comes on their way, no matter how small, for an idle or vegetating mind never builds but destroys the bridge to cross the river of recession.

Though engineers have given a very good account of themselves in carrying out the tasks entrusted to them, yet I exhort every member that he or she is the image of the Institution and a good or bad image of the Institution will be reflected through what they do and how they serve the community. The Institution is what we make it.

Thank you.

Shri T R Gupta—a Brief Profile

Shri T. R. Gupta born in 1910 in a village in the State of Haryana, was educated in the Banaras Hindu University, got his bachelor's degree in Electrical and Mechanical Engineering in 1934.

Immediately after graduation he started as an unpaid Apprentice Engineer in Delhi Cloth & General Mills Ltd., and was promoted as Chief Engineer of their Textile & Sugar Mills. He was transferred to Messrs, Jay Engineering Works Ltd., at Calcutta, in the year 1941 and had been working as its Technical Director and General Manager for over 23 years. He has been responsible for projecting, planning and installing about a dozen modern plants and operating them successfully .

He is one of the principal executives of Shriram Group of Industries. He takes keen interest in the training and education of technical personnel and has been associated with various Technical Institutes in the country as a member of Board of Governors.

Shri Gupta is well known for his good business acumen and efficient industrial administration. He is a self-made man and has set up half-a-dozen engineering industrial units in which his family has substantial interest. The Government of India appointed him as Chairman of Heavy Engineering Corporation where he worked $3^1/_2$ years on an honorarium of one rupee per month. He is at present a Director of Hindustan Steel Limited, Shriram Refrigeration Industries Ltd., Shri Ram Bearings Ltd., Electrical Industries Corporation, India Hard Metals (P) Ltd., India Capacitors (P) Ltd., PVC Wires and Cables (P) Ltd., Gupta Machine Tools (P) Ltd., etc.

Shri Gupta was the leader of the first Management Impact Team, sponsored by N.P.C., and visited West Germany, the U.K. and the U.S.A. He has been abroad many a times and has visited various modern industries all over the world.

He has been associated with various Development Councils and has been the Chairman of Development Council for Light Electrical Industries. He is the Founder- President of the Institute of All India Foundrymen and is the President of the Indian Council of the Institution of Production Engineers, London.

He takes keen interest in the management development activities and has been associated with the Calcutta Management Institute and has been the Vice-President of the Calcutta Productivity Council. He is the Chairman of the Central Mechanical Engineering Research Institute, Durgapur, and takes keen interest in the research and development work and has set lip design, development and research departments in all his industries.

He is a past President of the Engineering Association of India. His industrial activities are not confined only within the boundaries of India; he is now setting in joint participation a precision gauge and tool unit in Malaysia. He is giving technical know-how and will be sending a number of technical experts there to instal, train and operate the plant. He considers that close technical cooperation with the neighbouring countries is the surest-means of enhancing goodwill for mutual benefit. According to rum, the indian technicians have necessary expertise and skill and can successfully establish technical cooperation.

Lt Gen R A Loomba

President 1970-71

Presidential Address

1. I should thank most sincerely my colleagues on the Council for the great honour they have done me in electing me President for this year. It is an honour which I greatly appreciate and a responsibility which I do not underrate. As President, I am succeeding Shri T R GUPTA, who is a well-known Industrialist and it is perhaps more than a mere coincidence that a soldier should succeed an Industrialist, as the defence of the country is so vitally dependent upon the efficiency of the Industrial sector.

2. As a soldier, I have the privilege of belonging to a disciplined and integrated organisation, the Defence Forces of our country, and I am conscious of the fact that never before has there been a greater need in our country for disciplined, and integrated thought and action in all aspects.

3. As engineers, each and everyone of us, whether in uniform or not are concerned with discipline and integration some way. I am sure, you will agree with me that the disciplined and all-India integrated outlook of our Institution is one of the foremost requirements of our times. At this Annual Convention, which coincides with the Golden Jubilee of the Institution, I would like to mention that we, in the Institution, are proud of one thing that is the continuity in the thinking and the functioning of this august body of professional engineers over the last half a century. A great deal has been achieved but this is not enough, a lot more still remains to be done.

4. When the Institution of Engineers (India) was founded in 1920 with a membership of 138, its objects and purpose included the promotion and advancement of the Science, practice and business of Engineering in all its branches. I have no doubt that the Institution remain continuously aware of the duties for which it was constituted. These will not change. Change,

however, is atomatic to progress, as it should be, and just over 6 years ago, in October 1963 to be precise, with a view to further, the work done by our Institution, a new version the bye-laws was adopted by us. This was an important step in the right direction and during these last few years, under the able guidance of prominent persons who have been its Presidents, the Institution has modernised itself in a number of ways. Today we have 18 Local Centres and 28 Sub-Centres of the Institution and a total membership of all categories of over 65000. I feel proud to stress that the Institution caters to modern engineering needs in India of over covering the different disciplines of engineering and providing a common forum for engineers in diverse fields.

5. I would particularly like to stress the essential requirement for an Institution of this type for the development of an engineer. The Institution provides the engineer with encouragement, unity and strength, and gives him a certain status as a member of the profession of engineering, which has a distinct code of ethics. Further, the Institution provides him with a sound and progressive means of keeping abreast with technical developments that are taking place in the world. In a way, the education of an engineer starts only after he has obtained his basic engineering qualification, This education is progressive and he builds on it regularly and constantly throughout his professional career. If he does not do so, he runs the risk of becoming obsolete and ineffective in his profession. To enable him to keep abreast with new developments, the Institution provides him with a forum for discussion through regular lectures, discussions, seminars and symposia, where he can meet and exchange views with other engineers on problems of common interest. Without this contact, his outlook would tend to remain in a narrow groove, which no technologist can afford.

6. As you are all aware, we have a regular system of publishing technical journals in all the disciplines which form our Institution. Experience, however, shows us that, by and large, the contributions to these journals tend to have a greater academic and research bias. I would therefore like to appeal to brother engineers who are responsible for execution of works to record their experiences, and the problems that were faced and overcome during execution. Such records would be of invaluable help to the younger generation and the lessons learnt would not have gone in vain. Further, I feel that there is an urgent requirement for engineers to contribute articles of a popular nature to our newspapers which would arouse the technical awareness of the public, and also, at the same time, emphasise the contributions made by the engineers in the development of the country. The public, by and large, tend to take the engineers for granted. It is up to us to project a correct and appropriate 'image' of ourselves to the nation. There also appears to be a requirement for creating, (or helping to create) a translation service to make available information on the latest progress, ideas and development from other countries.

7. As an Institution we are and we will remain a non-political organisation but that does not prevent us from concerning ourselves with what is happening around us. The objects and purpose for which the Institution was constituted are to promote the general advancement of engineering and, engineering sciences and to promote their, application in India. It is, therefore, an essential part of our duty to look at the changed and changing circumstances encourage steps taken In the right direction, also to take warning if we are going wrong and correct wrong trends before it becomes too late.

8. We, as an Institution, have a responsibility for ensuring that the standards in the engineering profession are raised and maintained at the highest level and that the Corporate Membership of this Institution is the hallmark of quality which the public can accept and trust. We are intimately involved with all types of engineering activities with Universities, Research Institutions, Consultants, and Manufacturing and Construction agencies and I foresee a more intensive inter-action which will undoubtedly benefit the nation as a whole.

9. The Institution has both consultative and recommendatory roles and this should enable it to

contribute to the overall planning of development in particular country. In particular, it can recommend priorities for Public Works Projects, recommend the basis of Technical Manpower Planning with reference to each major projects and suggest scientific and technical targets which are realistic and credible in the context of the conditions obtaining in our country. Such recommendations coming from a non-partisan and professional body would, I feel, carry weight with the Government.

9.1 Another direction in which the Institution can do good work is Project Evaluation. There are too many economists and too few engineers evaluating the various projects. The injection of a little cold, hard, technical know-how will make any national project much more realistic. Connected with this is the question of project monitoring. There is no doubt that the cream of the engineering- profession which is available with the Institution can do an expert job in watching the performance of important national projects and indicating the lines on which these projects could be progressed further.

10. It is a well-known fact that many great advances in engineering were first shown the light of day by their progenitors at technical gatherings and discussions of the relevant institutions. We therefore need to develop and provide the necessary encouragement and environments to our younger members to enable them to develop the required personality, experience and stature for discharging the responsibilities that would increasingly be theirs. Only thus will be encouraged the raising of professional standards in our profession.

STUDENTS

11. One of our important constituents belongs to the category of students. The Institution provides them with opportunities to train themselves professionally and also to improve their career prospects. For this purpose, Student Chapters have been created, and committees formed at all Local Centres and at the Headquarters to look after their interests. But there is still something to be done and the Institution is paying close and detailed attention to improving the facilities further and evolving a more progressive and realistic syllabi for them catering for the changed technological conditions.

SOCIAL REVOLUTION

12. In the last two decades, there has been a tremendous social upheaval in this country and a social revolution is in progress. This revolution has tended to break the joint family as a unit and to draw the people from rural areas to urban areas in search of a living and higher standards of amenities and comfort's.

13. We have to sadly admit that as a nation we have done little for the rural areas. The rural population is migrating to the cities because it cannot make a livelihood in and around their villages. They cannot do so because the engineering required for agricultural and for other rural pursuits has not been advanced to the extent necessary. Engineering can help much not only in irrigation as of old, but in the matter of agricultural implements and machines, dairy equipment and even in projects requiring fertilisers to be used. Engineering can also help the villager to remain in the country-side by bringing to him the amenities of civilisation i.e., electrical power, roads, better housing, water supply and other amenities. Being a military engineer, you will doubtless understand that my thoughts naturally turn first towards road-building. In promoting the uplift of the rural areas, a countrywide rural road building programme will go a long way. You are all aware of the work done in our border areas where some of the most difficult terrain in the world has been opened up by the construction of roads. I have had the privilege of being the Director General of Border Roads and have first-hand knowledge of the tremendous work and skill that has gone into road building programmes in the most difficult type of terrain, and under the most unpleasant climatic conditions. Roads have been carved out at altitudes of 18000 ft. and in temperatures 20-30°C. below freezing point, when the strains on men and

machines are almost at the breaking point. In spite of these, some of the finest roads have been built, which I am sure, will go down in history as a great achievement of the Indian Engineers. Surely, we can have massive countrywide road building and also rural electrification programmes which will carry the benefits of civilisation to the villages, however remote they may be—due to deserts, marshes or high and inaccessible ains.

14. This social revolution has, in a way, been the consequence of greater mechanisation and better education. The stresses and strains of present-day society have considerably altered the problems of man-management and leadership in the technical field has greatly changed and become more complex. We, as engineers, must of these changes and evolve more modern concepts methods and procedures to function efficiently.

15. Although we may take pride in the tremendous progress made since Independance, yet, considering the period over which it is spread, we cannot help feeling that it has not been fast enough. The people are naturally getting impatient at, what they consider, a slow pace of progress. It is true that politicians and are also concerned in all this, but we, on our parts as Engineers, must ensure that through modern methods and techniques, and use of new materials, not only the costs of production are reduced but the speed and quality of production improved. In the interest of efficiency, we must also replace outmoded methods by more scientific methods both in the field of management and decision making. It is up to us as Engineers to study and understand these tools and employ them so that we may make sound and economic decisions, as this country cannot afford the luxury of mismanagement and adherence to outdated conventions and procedures.

ADMINISTRATIVE CHANGES

16. I would now like to turn your attention to the very urgent needs for changes in the administrative structures in this country. It is generally acknowledged that advanced techniques have begun to reach industry, whose outlook is more modern than ever before. This is a welcome and encouraging sign, but in the field of administration, we are still far behind depending on 0 rules and procedures, quoting past precedents and relying on instincts and compromises for important technical decisions. There are increasing political pressure in these fields, and with generalists at the helm of administration, our actions remain rigid and far removed from the changing and growing needs and aspiration of the people.

16.1. The result of this pattern is that the technocrat does not normally have direct access to the policy making head and his views are diluted and modified to suit pressures and precedents. Further, experiences the technocrat has to spend most of his time to make the generalist administrator appreciate the technical implications, which time he could more profitably use in doing the job. This is the state of affairs which is largely responsible for our present-day ills in administration and unless these are rectified ruthlessly and with speed, our pace of progress will continue to be slow and will soon come to a grinding halt.

17. It is disheartening to see that the rules and regulations procedure sand precedents, applicable to Government departments have been extended to public sector undertakings. The obsolete administrative and accounting system have been transferred to enterprises which need to be progressive, business-like and modern in their outlook and functioning. The result is red-tapism, fat files, delay low returns for the capital invested and, of course, shortfall in production.

18. It is, however, heartening to see that some change is noticeable in the attitudes at higher levels and I hope, in the near future, more and more technical men would be placed at the helm of enterprises dealing with technical subjects. Further, I hope that as most planning involves the spending of money on engineering projects, Engineers would be associated with these planning bodies because their serving on such bodies would result in a much more realistic appreciation

of the difficulties and would probably result in the Plan in fact coming into being as dreamt of at first.

FOREIGN KNOW-HOW

19. We should all be somewhat concerned with the way in which we have been in the past, and continue to be at present, dependent on foreign know-how for many of our works. Besides being somewhat galling to the ego, the country is losing a lot of money in continuing its dependence on foreign countries. Obviously, this is not a healthy situation. There are two aspects to this problem. One is technical education and the other is encouragement to native talent. So far as education is concerned, our Universities offer syllabi in all disciplines — or in almost all disciplines — at standards which are available anywhere in the world. However, I am not so sure that the actual benefit derived by the student is comparable to that in the foreign Universities. I say this bluntly because it is time that some one faces the facts. Not only are the hours of teaching in our Universities longer than in the foreign ones, but the ratio of Professors and Asst. Professors to the total student force is low. The restricts avenues of promotion, thereby making the teaching profession a somewhat unpromising field. This state of affairs, which applies to a majority of teaching Institutions, must be remedied if the standard of technical education in the country is to improve and need of foreign know-how is to be eliminated.

20. We have a number of consultancy organisations in our country which are doing excellent work. Although at the national level, education, research and development inventions etc. are being encouraged, yet our consulting engineers have been somewhat neglected. In almost every advanced country, consultancy occupies a special place in technological advancement. Quite often, the Government finds itself unable to turn to Indian consultants because of unfavourable bilateral agreements or package deals with foreign collaborators or aid-givers. We hope that the Government and other organisations, when entering into arrangements for financial aid, supply of equipment or other know-how, would ensure that Indian consulting engineers are given their rightful important projects.

UNEMPLOYMENT

21. The growing unemployment amongst Engineers is a burning problem and has been causing a great deal of concern to all of us. Last year the Institution set up an Action Committee under the Chairmanship of Shri T. R. Gupta, which swiftly went into the problem, and enabled the Institution to take steps in many directions — most of them yielding fruitful results. The basic philosophy followed has been to make unemployed engineers stand on their own legs, rather than becoming mere 'Job Seekers'. It is on the initiative of the Institution and, the personal efforts of our two past-Presidents, Dr. Triguna Sen and Dr. K. L. Rao, that we have been able to make substantial progress by forming Regional Employment Bureaus at Local Centres and by getting the Ministry of Education to secure 4, 440 additional training places for one to two years. Further, steps have been taken to get contractors to employ qualified personnel on sites of work, and the Reserve Bank to relax the current policy so that engineers and technologists can obtain credit to go into business on their own and set up small scale industries. We are conscious of the fact that this is not enough and that a lot more needs to be done.

DEFENCE PROBLEMS

22. It is the practice of the incoming President to deal with some aspect of the branch of engineering with which he is most concerned. I shall briefly deal with the role and functions of the Defence Engineering Services and also of the nature of engineer-tasks that can be foreseen in a future war. I shall deal mainly with the Corps of Engineers to which I have the privilege of belonging.

23. The history of the Corps of Engineers covers a period of almost two centuries during which

the military engineers played an important role in the development of this country in the field of irrigation and communications, both roads and railways. It is a tradition with the Corps that we take on the unusual in the initial stages till the task an be fully developed and entrusted to a new organisation and we look back with pride and satisfaction that the Engineers were responsible for the beginning of the Air Force, for the development and introduction of the tank, and the formation of the Corps of Signals.

24. The Corps have largely contributed to the organisation and efficiency of the Survey Service in the country. Whilst recapitulating the past, I would like to mention the part played by the Military Engineers in the sphere of technical education through the premier engineering colleges at ROORKEE, POONA and MADRAS. The duties of the Corps of Engineers are so diverse and cover so many different fields of engineering that we embrace and accept all disciplines of engineering within our fold.

25. It is important that in our planning and thinking we are ahead of the enemy. There is a great tendency to think in terms of what happened in the past forgetting that because of technological and scientific developments, no two wars have ever been similar. We must, therefore, prepare ourselves for the next war and not for the last one.

ENGINEER-TASKS IN A FUTURE WAR

26. I shall now turn my attention to the future, and try to determine the magnitude and nature of Engineer-tasks in a future war.

27. The modern concept of 'a nation at war' makes all engineers in civilian life 'unpaid members' of the Engineering Corps of the Services, as they would be directly and indirectly contributing in the solution of engineer problems that may arise in a future war. It is a well known fact that the most important and revolutionary advances in Science and Technology are made under the stress and strain of war to meet the demands of the Armed Forces in the fight for national survival. The Engineering profession as a whole must therefore take an interest in military problems and be prepared to shoulder the very heavy responsibilities that fall upon it, as modern wars are in the ultimate analysis fought and won by engineers and technologists.

28. A look at the map will show that because of the undeveloped nature of the terrain on our Northern and North Eastern borders, and the particularly difficult conditions obtaining in these areas, a war on our borders would be an "Engineers' War". Other components of the Army, no doubt, have their traditional tasks to perform, but the critical issues would concern the solution of Engineer-problems, and success would ultimately depend upon the equipment and performance of the Engineers.

29. A major development of recent times has been the production of guided missiles and nuclear weapons as the forces of mass destruction. This will inevitably lead to greater dispersion of our forces in their employment, as well as the dispersion of our industrial installations. In the tactical battle, heavier field fortifications, with adequate protection against nuclear weapons, are required to be constructed with speed, thereby requiring greater machine effort than in the past. Dispersion would also impose a heavier strain on the communication systems and transport support provided.

COMMUNICATIONS

30. 'Administration' which is synonymous with 'logistic support' is now an accepted principle of war — its importance having been again forcefully demonstrated in the last war by the concentration of superior forces at the right time and place. Sound administration is entirely dependent upon a reliable system of communications. It will be the enemy's constant endeavour to harass and disrupt our communications. Equally, it will be our duty to develop, improve and maintain all the different forms of communication systems upon which the

Defence Forces are dependent, and to ensure that the minimum disruption takes place.

31. The communication systems broadly cover roads which give the maximum flexibility to the Commander for the deployment of his forces and thus greatly influence the employment of strategic and tactical reserves for a battle. It covers air transport as no means of communications can be faster than this and it affords great mobility to our land forces. It covers railways and inland water transport, the development of which is vital for defence requirements.

32. It is important that the civilian organisations responsible for communications prepare themselves to be able to maintain the system at a high pitch under the stress and strain of war. The magnitude of engineer-tasks is so vast that the Corps of Engineers would have its hands full, and in the national interest, the Corps in war time should be relieved, as much as possible, of tasks which are within the capacity of civilian organisations. Further, there will be increasing dependence on machine power for speedy execution of Engineer-tasks, and necessity for constant study and evolution of new methods and techniques in various fields of engineering. There is a constant need to assess the strategic and tactical requirements of the Defence Force and to incorporate their demands in the design and planning of our transportation systems. The cost of doing this at the initial stages would be much less than carrying out the required changes under war conditions.

INDUSTRIAL BACKING

33. We may know the problems that are likely to face us in a future war, but this knowledge is of little help, if our industry is not in a position to develop and produce the equipment that we need. Our aim is self-sufficiency and this would only be achieved when there is a greater defence consciousness in the nation as a whole and greater collaboration between the Services and the industry in the field of development. We, military engineers, like to make maximum use of commercial equipment and standardise upon it, for then and then alone would we be able to employ effectively civilian resources made available to us at the outbreak of hostilities. Plans must also exist to convert civil industry to war requirements at short notice. I do not propose to expand any more on the many ways in which engineering can contribute to success in the land battle. Modern wars require mass employment of machines with their attendant problems, and new weapons dictate methods of warfare which have profound influence on the nature of military engineering. Whatever the precise nature of engineer-tasks in the future war, it seems inevitable that their urgency and their scope and magnitude would impose a severe test on the entire engineer-resources of the country, and on their technical skill and production capacity. The effectiveness of engineers-efforts depends on increasing mobility and speed of execution, reducing bulk and weight of required, and doing more and more with less and less.

34. I come now to some problems which are uppermost in my mind in relation to the Armed Forces. In a way these problems concern all of us, because in the final analysis they relate to our military preparedness to meet aggression, whichever quarter it may come from.

35. The first problem concerns the efficient manning of the Defence engineering organisations. It is paradoxical that with the glut of engineers in the country, this should be such a serious problem. But the reason is not far to seek. The Engineers and technicians in the Services have to be not only good technically but also soldiers. And, inspite of the popular view, good soldiers come from the 'top-third' of students for whom there are easier and more remunerative avenues of employment in civilian life. This difficulty is increasingly making us train our own officers and men in the technical field, and I am happy to say that the standards achieved are very high indeed. But it means duplication of training effort, resources and time.

36. The next and far more serious problem is the lack of research and development consciousness in our industry generally. No nation in modern times can survive a major conflict

unless it is self-sufficient industrially, and is able to gear all its resources towards the war effort. This is not to suggest that the industrial effort in peace must be unnecessarily war-oriented but what is essential is a strong research and development element in all industries, which will tend to make the nation industrially stronger and self-reliant, two essential requirements to switch over quickly to war production in times of an emergency. That this is required for economic development also needs no further emphasis.

37. Military Engineers must remain in touch with the mainstream of engineering thought and development in the country. This they can only do by remaining in touch with the leading national institutions and research establishments and by taking part in their activities and deliberations. It shall be my endeavour to strengthen this relationship and bond, and to make both aware of their inter-dependence. We have always given our fullest support to the Institution of Engineers because we feel that there is no better instrument for establishing this bond, and we will do all in our power to ensure its proper growth and development in the future.

THE FUTURE

38. In view of the tremendous advances made in engineering and technology in the past, I consider that the Institution has a great role to play in the development of this country. I see the Institution bringing all engineers and technologists together under its fold in the service of the nation. I see our horizons widening beyond narrow national spheres and enlarging into international dimensions. Today this is but a vision and a dream, but we must find ways and means of doing it and of having it done. The responsibility for transforming it into reality rests on all of us.

Lt Gen R A Loomba—a Brief Profile

1. Lt. Gen. R. A. Loomba was born on September 17, 1916. and studied at the Rangoon University and at the Indian Military Academy Dehra Dun. He was commissioned into the Corps of Engineers in July 1938. He received his engineering education at the Thomason College, Roorkee, and the School of Military Engineering. During the Second World War, he served with active formations in Sudan and Fritria, Middle East Theatre, Paiforce and South East Asia Command.

2. In August 1948, he assumed the command. of Madras Engineer Group as a Colonel, in which appointment he was responsible for the technical trainning of officers NCOs and men of this Group which forms nearly one-third of the Corps of Engineers. This was an important period soon after Independence and as the Commandant, he organised and directed the training of a large number of officers and recruits.

3. He was appointed Deputy Commandant of the School of Military Engineering in 1961, an appointment which he held for a period of 2 years. This School conducted tile training of young officers of all the three technical Corps of the Army-Corps of Engineers, Signals and Electrical and Mechanical Engineers, and the courses are recognised as being equivalent to an Engineering Degree. He was also directly responsible for the conduct of various research problems In the Engineer Research Wing of the School concerning military engineering problems, like soils, highways, airfield and building construction.

4. He was then appointed Deputy Director of Works in the Engineer-in-Chief's Branch at Delhi. In this appointment, he was responsible for the planning of works Services for the Army, which included, domestic, technical and other accommodation. In 1955, he was appointed Chief Engineer of a Command where he was responsible for all engineer projects for the Army and Airforce in that particular theatre and for the technical training and employment of engineer troops. During this period, the bulk of the Army was located in this Command.

5. In 1959, he was appointed. the Commandant of College of Military Engineering, Poona, where he was responsible for the Post Graduate training of Corps of Engineer officers and graduate training of all technical officers of the Army. The College also conducted the higher technical training of Engineer craftsmen and combat engineer training of all arms of the Army.

6. In 1960 he was appointed Director General of Works, an appointment held by him for a period of 5 years. In this capacity, he was responsible for all the works projects of the Army, Navy, Airforce and the Ordnance factories. The total work load during this period amounted to Rs. 100 crorcs per annum. This included major projects like an Explosives Factory, Heavy Vehicles Factory and modernisation of a number of ordnance factories and large scale expansion of cantonments, ordnance depots, military hospitals ana workshops. It was during this period that the Chinese aggression took place, the Army was expanded considerably as also the works services. Under the guidance of Maj. Gen. Loomba these tasks were carried out with originality and enthusiasm. A number of air fields and air stations with technical accommodation were also constructed with speed. He was also responsible for the construction of laboratories for the Research and Development Organisation including the Institute of Armament Technology at Kharakwasla.

7. With this experience, he was considered to be the most suitable officer to take over as Director General of Border Roads in 1965. This Organisation is responsible for a large road construction programme in border areas which have problems peculiar to these areas. A special engineering organisation and knowledge to tackle the difficult problems encountered is therefore necessary. The Organisation is self-sufficient and has its own supply and logistics elements including Base Workshops. As the Director General, Maj. Gen. Loomba planned and executed a number of important roads in these areas. The work load increased considerably after the conflict with Pakistan.

8. In 1967, he was appointed the Engineer-in-Chief which appointment he holds today. In this capacity, he is responsible for all the activities of the Corps of Engineers and for Engineer support to the three Services — Army, Navy and the Airforce. He is also responsible for the Research and Development of new engineer equipment, planning and design, execution and maintenance of various works projects, and for the technical education of the Corps. The work load is normally over Rs. 120 crores per annum and Lt. Gen. Loomba heads a department which is the largest engineering organisation in the country covering all major disciplines.

Shri J G Bodhe

President 1971-72 & 1972-73

Presidential Address

(1971-72)

एवं प्रवर्तितं चक्रं नानुवर्तयतीह यः ।
अघायुरिन्द्रियारामो मोघं पार्थ स जीवति ॥
—(श्रीमद् भगवद् गीता ३/१६.)

Arjuna, He who does not follow the wheel of creation thus set going in this world (that is, he who does not perform his duty) being sinful and sensual, he lives in vain.

(Shrimat Bhagavadgita)

Your Excellency, Ladies and Gentlemen,

I consider it a very great honour to The Institution of Engineers (India) and to me personally that His Excellency the President of India, Shri V. V. Giri, had kindly consented to inaugurate this 51st Annual Convention of the Institution. We, however, are equally happy that His Excellency Shri Brij Narayan Chakravarty, Governor of Haryana, has been kind enough to be amongst us for the Inauguration.

Shri Brij Narayan Chakravarty has been an illustrious member of the Indian Civil Service and has held with very great distinction various posts in the Government of West Bengal. He was the Finance Secretary to the Government of West Bengal and also the Political Advisor to the Allied High Command at Tokyo during the Second World War. Having held various important appointments in Tokyo, Korea, Canada, the Netherlands and Ceylon, he became the Special Secretary for Foreign Affairs. Shri Chakravarty was also India's Permanent Representative at the United Nations. In the year 1966, he took over the Governorship of Haryana, It is of particular interest to us that he is a Graduate in Science from Calcutta University having Chemistry as the principal subject. He also graduated from the London School of Economics. It is therefore no wonder that he has equally distinguished himself in diverse fields whether it is Finance, Foreign Affairs or Diplomatic Service. We are, therefore, extremely happy to have such adistinguished personality amongst us this morning.

This Annual Convention is being now held in the picturesque surroundings of Chandigarh reckoned as one of the most modern cities of India.

Earth has not anything to show more fair.
Dull would he be of soul who could pass by
A sight so touching in its majesty:
This City now doth like garment wear.

Wordsworth

Punjab has played a vital part in the history of India and its defence throughout the ages. The people of Punjab have fought, defended and borne the brunt of invaders across our borders. In spite of this, Punjab, though now split into three provinces, has set an example to the rest of India in industrializing its various cities and villages. A man from Punjab is a real example of an industrious, enterprising and persevering character. It was in Punjab that large scale agriculture was undertaken by the construction of a network of canals at the beginning of the 20th century and the hard working people of Punjab turned the province into a granary. I take this opportunity to compliment the people and the engineers of Punjab for their pioneering spirit in every field.

We are deeply grateful to you, Sir, for honouraring us with your august presence and thereby recognising the role of our Institution and its importance in the progress of the nation.

Let me take this opportunity to congratulate my distinguished predecessor, General R. A. Loomba, for the honour conferred upon him as the recipient of the 'Param Vishista Seva Medal' for his distinguished service of exceptional order. In my opinion, this great honour is conferred upon him for the services rendered not only to the nation but in particular to this Institution also.

I shall be failing in my duty if I do not express on this auspicious occasion my gratitude to my colleagues in the Institution Council for electing me to this high office of the President of the Institution of Engineers (India), an organization comprising the largest number of professional engineers of all disciplines in India. This conglomeration of varied specialities and disciplines makes it unique among the world's professional engineering societies. This is of particular importance in the present juncture when the boundaries of various engineering disciplines are intermingling so fast that the engineer is being called upon to execute work in interdisciplinary projects involving complex technology,

In our successive Five-Year Plans, Indian engineers have been contributing a good deal and successful carrying out projects of social and economic importance of unprecedented magnitude even without previous experience, and have proved that given the opportunities and responsibility, they would shoulder and executive projects of national importance with complete confidence. We may, therefore, legitimately claim that in spite of the fact that other nations of the world have developed advanced technology, our engineers can be relied upon to discharge their duty and responsibilities without diffidence. Engineers are now responsible for industrial projects of large magnitude. However, in spite of the advanced technology and the benefit that is derived by the society, we are responsible for the resulting pollution of air and water which perhaps is a greater problem than maintenance of peace. Engineers must, therefore, be alive to their responsibilities with respect to the science of ecology that is the balance and imbalance in nature.

CONSULTANCY SERVICES

This is brings me to the growth of Consultancy Services in our country. In the seasoned opinion of many, it is now high time that indigenous know-how should be encouraged by the Government by entrusting Indian engineers complete responsibility for handling complex , national projects. In sophisticated and very specialized fields where our know-how is limited, special consultants can be employed having such specialized knowledge so that the resulting experience remains in the country. I may, however, mention that I and many of my colleagues disagree with the trend of nationalizing the Consultancy Services since it would discourage initiative, stultify the creative faculty of the engineers concerned and render the services as a closed shop unaccessible to the people at large. I would, therefore, earnestly request that proper action should be taken by the government and suitable encouragement given for a free and unrestricted scope to Indian consultants by awarding them work of public projects.

It is true that due to suspension and delay in implementation of the Fourth Five-Year Plan, there is growing unemployment amongst qualified and working engineers. However, the government should be complimented for the right kind of action it is taking in providing all assistance to unemployed engineers for self-employment by way of starting small scale industries and undertaking construction contracts. We owe our gratitudes to the President of India, Shri V. V. Giri, for his bold lead in this respect advocating and proposing the employment of engineers on feasibility survey of future projects, I do hope that the excellent lead given by him will be translated into action by all the States.

The Government spends as much as Rs. 10,000 on every engineer for providing educational facilities. This is undoubtedly a valuable asset to the nation. I would, however, suggest that the Government should use its good offices through its various embassies all over the world to obtain design and consultation assignment in other countries where there is tremendous need for the without employment of engineers. This should be considered without apprehension in the wider perspective for increasing our export potential in various fields, more especially our products from industries. It is an experience common to many that our embassies abroad are least helpful when it comes to giving assistance to their own fellow nationals.

It is a welcome sign that our engineers have been deputed to various countries on specialized assignments, especially in the fields of education, irrigation, railways, public health engineering, etc.

TECHNICAL EDUCATION

Our present trend of curtailing technical education is short-sighted in view of the fact that when the Fourth Five-Year Plan, ambitious as it is, is taken up, technical man-power may be found to be inadequate. It is a common theory in economics that at the time of economic depression the State should invest more rather than curtail employment or industrial production. The same hold good in the case of technical education as well.

True, our technical education needs vital changes in order to render the end result more meaningful and enable college and polytechnic students to be immediately absorbed in various productive fields. Our Institution is vitally concerned with this aspect and has produced voluminous reports on the aspects of reorienting technical education in the country. The Institution is also continuously elaborating and collaborating on this subject with the various committees instituted by the Ministry of Education.

Another aspect of education which has been universally accepted is the introduction of humanities in technical education. As in other fields, if technical education is to play its proper role, the function of education should be to produce an integrated and educated engineer. It is, therefore, evident that the technical curriculum should necessarily contain history, philosophy and literature which help to fully develop the propensities of every person by enhancing his power of judgment and taste and imparting him with a balanced outlook so necessary for success in professional and social life. However, we must not beguile ourselves in believing that a smattering of humanities is the key to culture. The really educated man is distinguished by his attitude towards learning and method of thought rather than by mastery in a particular domain of knowledge. Engineering education can attain a lofty professional stature only through concern for principles, ceaseless search for fundamental and rejection of the immediately useful in favour of painstaking search for knowledge. It is gratifying that our engineering colleges have become conscious of their defects and are trying to apply the necessary correctives.

Whatever the shortcomings of the present educational system, education in science and engineering is on the move. However, engineering will not serve its useful purpose by mere narrow specialization unless its proponents have an abiding knowledge of the fundamentals of technology and science and an appropriate knowledge of liberal arts and philosophy which alone can give these educated men judgment and understanding and impart to them a correct attitude to serve the advancing technological society which is now emerging.

Education should be designed to enlighten and impart to the recipient a love for knowledge and wisdom to create continuous thirst for progressive thoughts and aesthetic appreciation. It should deal with human values which are supreme and problems that are endless. Education should prepare the student as well as the professional who is a life-long student, to read, listen, appreciate and equip himself with knowledge of advancing science and technology; and above all, it should lead him to appreciate all that is lasting of a man's work in art, music literature and thought.

In advanced countries, electronics and computers are becoming a way of life and are relieving the technologists, scientists and engineers of much of their laborious work. As a result, in times to come, they will be saddled with leisure which in itself will pose a problem, for solving which the whole humanity will have to devote attention.

SPIRITUAL VALUES

It may be pertinent to observe that the advance of technology, science and engineering has added to our physical comforts but has created within humanity an exceedingly great psychological and mental discontent. If we analyse the history of civilization and education, the origin of psychological discontent can be traced to an imbalance of physical needs and lack of human and spiritual values. The advance of technology has failed to keep pace with the spiritual values and the imbalance of technology and spiritualism has been the main cause of present discontent and psychological unhappiness.

सुखं वा यदि वा दुःखं प्रियं वा यदि वाप्रियम् ।
प्राप्तमप्राप्तम् उपासीत हृदयेन अपराजितः ॥

We are producing mere engineers who can do their jobs with mechanical efficiency. But we all wish to e nip them with human outlook, vision and purpose. To achieve this end, we are adding in their course contents humanities which include literature, civics, history, economics, industrial psychology and philosophy. This is to enable the students to acquire a sense of human values. As the Bhagavadgita puts it, we should aim at wisdom as well as knowledge — Jaanam Vijnana Sahitam, At a time when we are obsessed with technical achievements rather than with absolute values, with practical work rather than with a full life, it is good to realize that 'technology is for man and man not for technology'. The material things of the world have to be used for expanding man's knowledge and enriching the treasures of the spirit. It is not enough to feed the human animal or train the human mind. We must also attend to the needs of the human spirit. We must learn to live from a new basis, discover the reserves of spirituality, the sense of the sacred found in all religions.

न काङ्क्षे विजयं कृष्ण नच राज्यं सुखानि च ।
किं नो राज्येन गोविन्द किं भोगै र्जीवितेन वा ॥
—(श्रीमद् भगवद् गीता १/३२.)

The place of an engineer in society, especially in India, has been entirely anonymous. The engineer does his work in isolation from the society in which he lives and does not receive any accredited recognition from it for his achievements, although it is acknowledged that the engineering fraternity contributes most to the advancement and the good of the society. Very often, the engineer considers himself to be privileged and is satisfied with anonymity. However, the times have so changed that he must necessarily integrate more with the common man and mix himself with the society more freely, in order to be recognized as a benefactor by the common man. It is also now necessary that the engineer sells himself directly rather than work through a politician. He should assert his judgment and views more directly and forcefully to the society without favour or fear. It is my humble opinion that the present economic chaos in the country is due to the presence of nonprofessionals at the helm of decision-making positions who' mind economies and their complacent permissive policies rather than an actual economic confrontation by masters of economics and experts from the profession. If socialism for the greatest good of the greatest number is to serve its useful purpose and acclaimed objectives, dignity of labour as well as the right of fair living wages should be coupled with responsibility of production in every field. The economic ills in our country have been mainly due to a dichotomy in the right of earning and the responsibility of production.

The reconstruction of Germany after the last World War and the emergence of Japan as an industrially advanced nation are examples well worth emulating. This brings me to the role of engineers in a democratic society. In democracy which is rule of law and rule by majority, it is the duty of technologists and engineers to properly guide the majority in taking decisions on projects of national importance and interest. Engineers by their expertise, training and unbiased attitude are the right men to recommend and dictate decisions on matters related to engineering projects of national importance. National projects in India cost several crores of rupees and as such, the question of feasibility, importance, location and other pertinent aspects should rightly fall within the domain of engineers and not of politicians. The engineer should develop strength of character to take such vital decisions and dictate them to the society for bringing ths greatest good. It would, therefore, not be wrong if engineers of high calibre and status expect to find place in various legislatures so that their guidance, advice and assistance be available to the decision-making bodies. We claim hundreds of such persons of high calibre and it is a matter of pride that two of our colleagues are holding their rightful places in the Central Government.

However, it is disheartening that although there nominations to the Rajya Sabha (the Upper House our Parliament) from various fields like arts, liter and other allied subjects, representation from the engineering profession is practically nil.

I would not be asking much of the Government respected Sir, in requesting their valued consideration to include eminent persons from the profession engineering in the Rajya Sabha.

For the good of the country, it is necessary that we should find many such outstanding persons and nominate them to various legislature without having to go through rigorous electoral competition. The services of engineers should be rightly recognized by the society and the Government alike by proper appreciation due to them.

When I request the Society and the Government for what is due to us, may I ask of my fellow engineers to the contributions they could make in turn.

It is a common law that one must deserve before he desires recognition from the society. It is high time that we should apply introspection to ourselves to be worthy of the recognition we claim. Do we really have the strength of character to face the society in terms of what we have given to it in return for the privileges we seek? As engineers we are paid emoluments comparatively better than other professionals, but we consider the emoluments we receive as inadequate in comparison with the responsibility entrusted to us and the dedication we give to national work. But looking from the society end, how have we in return served the society, the poor and the needy in our spare time. Do we contribute to social welfare out of our emoluments? Do we contribute even a fraction of our time for any social service? The answer is invariably in the negative. It is no wonder therefore, we feel isolated from the society. Let us, therefore, devote ourselves more to social work as a part of our duty. There are hundreds of villages which need our guidance and advice. In times of nation calamities like earthquakes and floods, hundreds of engineers should extend their voluntary services to the affected community. In spare time: our engineering organizations and professional engineers should increasingly take upon themselves the work of improving village sanitation and water supply, construction schools and dispensaries and improving the living conditions in villages. In this way, we can be useful to the society, the nation, the humanity at large by contributing our mite to raise the standard of our poor and y brethren.

With this in background, I like to suggest that all our Local Centres should constitute a cadre of retired engineers who could undertake such welfare activities at the village and Zilla Parishad levels to serve the society and thereby win the recognition that is due.

ख़ुदी को कर बुलंद इतना कि हर तक़दीर से पहले।
ख़ुदा बन्दे से ख़ुद पूछे बता तेरी रज़ा क्या है॥

THE INSTITUTION AND ITS ACTIVITIES

The role of the Institution at the national level is of paramount importance. We have a membership of over 65,000 engineers in various disciplines, such as civil, mechanical, electrical, electronics and telecommunication, public health, chemical, mining and metallurgy. The civil engineering field itself comprises several groups, such as structural and prestressed concrete, railways, roads and numerous other specializations. There are still many well qualified engineers in the P. W. D., Railways and Government Departments who are outside Rolls of the Institution. Many of them ask as to what are the material advantages in joining a professional institution like ours. May I remind them that the Institution is built up by those who join it. It is not what the Institution does for the individual but what every members does for the Institution that essentially matters.

The Institution was established to propagate the science of engineering and promote its advancement by mutual discussions. The Institution publishes monthly journals in several engineering disciplines and disseminates knowledge through these publications as well as seminars, symposia, paper meetings, technical discussions and industrial visits, and by examining students professional competence. There is a reservoir of technical information in the country on completed projects of large magnitude. There is also plenty of information on the difficulties experienced in handling engineering projects and the solutions worked out for them; and this should be made available to all the engineers in the country. Those connected with Government engineering projects should make it a point to published their reports and make full information available the completion of the projects as a heritage to posterity. Technical films should be taken during the construction stages and exhibited to one and all to bring awareness of the magnitude of the work done by the Government and executed by the engineers.

The activities of the Institution are well known in the international field. The Institution should endeavour to establish its parity with similar institutions in the world and bring to their notice the colossal amount of technical activity generated in our country and the excellence with which it is being tackled so that the world may come to know the high calibre of our engineering fraternity.

TECHNICAL OBSOLESCENCE

In the context of the fact that the advanced nations are progressing at the rate of 22 to 25 percent in their technology while India and other under-developed nations are crawling at a mere 4 percent, there is bound to be a big gap between the two. If the intake of knowledge and communications from the advanced nations to us is to be maintained effective, we must design a virile line of communication, and create and provide a machinery which can transfer such information where needed. Engineers have, therefore, a special responsibility to keep themselves up-to-date in their professional knowledge and the only agency through which this can be achieved is a professional body like ours. This being the case, it will be the function of the Institution to disseminate knowledge to its members through a variety of learned activities, such as journals, seminars, symposia, refresher courses and personal discussions. And it is here that the Institution acquires a very great significance as a national clearing agency for advanced engineering knowledge and its membership becomes crucial. I need not, therefore, impress upon engineers as to why they should join the Institution as members. One who fails to join or does not realize the importance of joining a professional institution like ours is sure to run the risk of being condemned to obsolescence, unfit to continue as a professional engineer.

I have deliberately not covered in my address the phenomenal advances being made in the engineering field in this country. Our country is in the vanguard of prestressed concrete design and construction, bridge building, irrigation projects, dam construction, atomic energy development, heavy engineering, machine tool engineering and airport engineering. However, much remains to be done in the fields of electronics, chemical engineering, shipbuilding, oceanography and marine engineering.

Given due encouragement in consultancy services, complete responsibility and a bit of appreciation, our engineers can surely rise to full stature proving themselves second to none in the world.

Only where love and need are one,
And the work is play for mortal stakes
Is the deed ever really done
For Heaven and the future's sakes.

Robert Frost

(Two Tramps in Mud Time)

Let's therefore pray that:

ॐ सह नाववतु । सह नौ भुनक्तु ।
सहवीर्यं करवावहै । मा विद्विषावहै ।

समानी आकूती वः । समाना हृदयानि वः ।
समानमस्तु मनो वः । यथा वः सुसहासति ॥

Ah love! could thou and I with fate conspire
To grasp this sorry scheme of things entire
Would not we shatter it to bits—and then
Remould it nearer to the Hearts desire.

Omar Khayam

LET GOD BE WITH YOU.

Presidential Address

(1972-73)

THE ENGINEER IN AN UNEASY WORLD

DISTINGUISHED GUESTS, ENGINEER FRIENDS, LADIES AND GENTLEMEN:

I am very grateful to the Council of this great Institution for having bestowed on me the great honour of re-election as their President. I am conscious of the heavy responsibility that goes with this honour. You will forgive me if, at times, I feel a little overwhelmed and diffident because of the continuing responsibility that I have been asked to shoulder. I pray that I may have the strength to justify the confidence reposed in me and prove myself worthy of the choice.

On behalf of the Institution of Engineers (India) and myself, I am deeply grateful to Honourable Shri I.K. Gujral, our Minister for State for Works and Housing, for having so graciously accepted our invitation to deliver the inaugural address of this Convention and enlighten us by his mature advice on this occasion in-spite of the heavy demands on his precious time. It is also my privilege to convey our grateful thanks to Air Chief Marshall P. C. Lal (Padma Bhushan) for the honour he has done us by being with us to preside over the inaugural ceremony of the Annual Convention. My pleasure is two-fold: firstly because the Annual Convention is being held in the State to which I belong and I have thus the honour to welcome them to my home State; and secondly because their distinguished presence participation m our functions affirm their faith and interest in engineering and the engineer, with both of which they are so closely associated in their own high public assignments. We appreciate it more as we know, Sirs, that you have great tasks to perform in our present situation. I have also Immense pleasure in welcoming the distinguished guests and members of the Institution a large number of whom have come from long distances to attend and take part in the Convention.

On this august occasion, I feel it is our foremost duty to pay utmost regards to our Prime Minister and our homage and tributes to all our valiant jawans and officers of the Army, the Navy and the Air Force who as a single team have made supreme sacrifice for the country in the recent enemy aggression, bringing to our country the prestige it has achieved in the international issue of Bangladesh. It was not only the men of the defence services but their equipments as well that brought these results to us. The old horse the 'Centurian' outgunned and outfought the U.S.A. made Pattons, the Chaffees and the Chinese built T-59s. The Gnat and L-70 shooters on the other hand brought the enemy's Mig-19s in major assaults. Thus, it may be truly said that India won this war through sheer morality and superiority in every field of defence, leadership and human intelligence through its courageous and determined man, fire power, intellectual planning, military strategy and tactics, readiness to adopt indigenous engineering techniques and equipment and morethan all through its vision and supreme confidence not to go back without justice done to an oppressed people. I have brought these to your notice just to focus attention to the fact that this brief but destructive war has also emphasized on us the vital role that indigenous design and development of engineering and technological equipment and materials as well as the need for expert engineers who are the very of the country's progress have on national security. We have hundred of engineers in the Defence Forces defending our motherland and the developments that we have achieved in our defence have been due largely to the technological progress made by them. These engineers are called upon to match up their efficiency and operational fitness not only as engineers but as soldiers as well. They have indigenously designed and developed quite a lot of equipment such as tanks, heavy guns, radar, communications and wireless systems, aircraft and other newer weapons, which are essential to mechanize the defence. As an age of eletronics, our trend is bound to continue requiring fast specializations and rapid implementation of integrated plans for the country's security. It has been rightly said that the recent battle was a battle for the engineers and in this context, the army engineers, most of whom are members of the Institution, have played a great role in the liberation of Bangladesh. In the difficult riverine terrain of Bangladesh, the mobility of our advancing forces and their perfect maintenance totally depended upon the capability and prompt actions of the Corps of Engineers. Their support was required at all stages—in building and reconstructing numerous bridges which had been blasted off by the enemy. They had to clear extensive mine fields in the path of our advancing men and equipment—in fact, a .highly dangerous operation but overcome by selfless sacrifice and unchallenged determination. They had to keep the runways and taxi tracks fit for operation in the face of repeated air attacks and raids by the enemy. The Corps of Electrical and Mechanical Engineers had an all-out active part in the rebuilding operations and in maintaining in perfect trim the numerous varieties of technical equipment and vehicles used by our defence forces. This also involved recovery of damaged equipment and replacing them in the shortest time. The workshops in the base areas had to put up immense effort in carrying out heavy repairs on mechanical equipment and electronic armaments. Our telecommunication engineers of the Corps of Signals worked round the clock to establish vital communications of the advancing forces.

Thus, but for the great and risky tasks undertaken by the defence services engineers in maintenance of Air Force, Naval and Army equipment, restoring vital road links, railroads, airfields, ports and docks, it can be safely said that the liberation and rehabilitation of Bangladesh could not have been as speedy as we have witnessed it to be. Our brave and devoted engineers without the fear of hazardous attacks and sure death all the time, have done marvellously and selflessly to safeguard the security and prestige of our country. We can only honour them as we have now honoured our men of the three Services with distinguished service recognitions. This is the best that we could do as humans. But the sacrifice and the sacred and unselfish engineering deeds they have done will live to posterity recalling to us the great lesson that it is we who should step into their shoes in times of need.

ENGINEERING AND ITS TASKS

The subject that I would like to talk to you about is one that I know you will have heard a lot about in the past, namely, the 'Engineer' and the key role played by him in building up the Society and its prosperity without even knowing what contribution he has made towards this end. In spite of a lot of talk and discussion on the role of the Engineer, we have remained confused with more and more questions cropping up such as: What are the responsibilities of the engineering community in the future development of the nation? In which direction should we be moving?

From the engineers' point of view, there are some who believe that the engineering profession should stick strictly to the technical end of the business. There are others, however, who believe that engineering fraternity must broaden its responsibilities in the larger sphere of social welfare of the State. Yet there is no agreement on how this broadening should be done, or through which instruments.

Despite the engineering developments that have reshaped the modern world, there has often been a tendency in the popular mind to confuse the goals and purposes of the scientists on the one hand with those of the engineer on the other. Yet the distinction is clear enough. The task of the engineer, let me stress again, is to use the scientific information in the most practical and effective way possible, and to create the devices and systems that are needed for the comfort, convenience and progress of modern man.

DROWNING IN COMPLEXITY

Two-thirds of the people alive today will live to see the year 2000, what the world is going to be like in the 21st Century. Priests and seers have done that in all ages and among all peoples, believing in secret powers and supernatural potents. All these were concerned with divining the future, though the true future declined to reveal itself. Now we no longer have the capacity to dream and believe in the supernatural. In this age of interplanetary communications and satellite travel, we have become hard boiled realists.

The human society, by becoming more and more specialized, has been getting itself into a very precarious position. Although engineers and scientists have developed the ability to use the energy of the atom to perform extraordinarily large tasks, we have no world authority to say on what we ought to do with this ability or how well we may use our energies in important and constructive ways. On the other hand we find how our energies are being developed in enormous ways for no better purpose than to destroy man. In fact mankind is by now technologically capable of eliminating man himself from the earth by a very elaborate system of retaliatory key boards requiring only pushing of control buttons to attack or retaliate.

An entirely new responsibility for man is clearly emerging as a result of fallout from technology developed primarily for war purposes between the beginning of 20th Century and as at today. More than 40% of the world's people today have higher material standard of living than could have been imagined before the turn of the 20th Century when only 1% of the population lived a life of high standard. This was as a result of any consciously organized work on man's part . . but rather as 'fallout' of man's acquiring greater productive capability, under the threat of fear and aggression, and without any understanding of what wealth really is or what he could 'afford'. Man thought that what he could afford was something held by the powerful man. The powerful man had something he called capital with which to finance his undertakings; if he said he didn't have the necessary capital, then he couldn't 'afford' it. In these last statements, there is no realization of what wealth really is. Our understanding or lack of understanding of this point— what wealth really is have a whole lot to do with whether or not man going to survive on the face of this earth.

At the end of the war, it became apparent that, in many areas, our wartime achievements has directly application to peacetime goals, and it seemed evident that, in some respects at least, a continuation of the methods and practices which had brought us military success might be desirable in peacetime. If a nation had to maintain its technological superiority and stay ahead of the rest of the world, it seemed obvious it must continue to nourish and use engineering and science.

TECHNO-ECONOMIC SITUATION

It is in such an environment that I like to make brief reference to the economic and technological situation in our country. Faced as we are now, people are inclined to be despondent because of various set-backs, such as recent hostilities and aggression by neighbours which have necessitated the channelling of vast sums for defence — sums which would have otherwise been used for increasing the prosperity of the nation; general feeling of frustration due to political, regional and linguistic squabbles; a deterioration of moral values in certain quarters; and incompetence in other places. This is the dark side of the picture.

All the same, everyone of our ventures has the bright side too. There is considerable evidence of solid achievements which one cannot ignore and should not belittle. There is no dearth of talent in the country and the spirit of dedication is very much in evidence. The engineer, conscious of his responsibilities, has been contributing constructively and enormously to the country's progress and as Pandit Nehru had said, 'the future of the country will depend more on engineers rather than on administrators'.

The result of all this has been that engineering is in a constant state of evolution in the country. Developments such as atomic energy, electronics, space research, satellites and hybrid yields in agriculture are being achieved at an ever increasing pace. Simultaneously numerous other technical advances with far reaching consequences such as automation, computers, etc., are being adopted.

We are on the threshold of the Fourth Five-Year Plan. Our installed capacity for energy production is very small — about a hundredth of that in the U.S.A. or U.S.S.R. To reduce poverty and get sufficient food, we have to industrialize and produce things. It is here that energy plays the key role. During the last year, the consumption of energy in the country rose by 12.6%. Out of the total energy produced in the country, 42% is from oil, 46% from coal and 9% from hydro works. Among these energy resources, coal is an indigenous product. However, geographically, coal is situated such an imbalanced way that we cannot take full economic advantage of the coal mines.

The Fourth Plan is meant to provide the next step forward in attaining accepted aims and objectives of Indian planning. It aims at acceleration of the tempo of development in conditions of stability and reduced uncertainties. It proposes to introduce safeguards against the fluctuations of agricultural production as well as the uncertainties of foreign aid. Together with programm increase agricultural production, the Plan provides for the building of sizeable buffer stocks to our supplies of foodgrains and other measures to stabilize foodgrain prices and the price level in general. In regard to the financing of the Plan, emphasis is being placed on additional mobilization of internal resources in a manner which will not give rise to inflationary pressure.

We have now done away with concessional imports foodgrains under PL 480. Foreign aid net of debt charges and interest payments will be reduced to about halfof the current level by the end of the Fourth , Other imports will be reduced to manageable portions.A sustained increase of exports by about ayear is being aimed at.

WHAT OF ENGINEERING:

Obviously, the Fourth Plan calls for a gigantic transfer of technical momentum from all walks of life, specially the engineering profession. The Plan should, therefore, turn its attention toward creating the engineer can provide the professional leadership the country needs, for it is the engineer who can help shape a new humanism to our society. 'Engineers are the chief revolutionaries of our time', says Prof. Lynn White (Jr.), a famous historian. 'Their implicit ideology is a compound of compassion for those suffering from physical want, combined with a Promethean rebellion against all bonds, bonds to this planet. Engineers are arch-enemies of all who, because of their fortunate position, resist the of the mass of mankind toward a new order of penalty, of mobility, and of personal freedom. Within the societies which have consolidated about the Marxist and the Western democratic revolutions, engineers' activities are the chief threat to surviving privilege. Without deliberate intent, but by the nature of their, activity, engineers have largely destroyed the contemporary validity of the older aristocratic humanism which was a cultural weapon in the hands of the ruling class. When engineers in greater numbers come to know explicitly what they are doing, when they recognize, their dedication they can join with alert humanists to shape a new humanism which will speak for and to a global democratic culture.'

The socio-technical or scientific-humanistic programmes of the nation include such undertakings as programmes in urban and rural affairs in health-related activities, in psycho-social studies of man-machine relationships, and in the pursuit of the life sciences. In these programmes, there is a preoccupation with specific problems relating to the human condition, such as poverty and pollution, urban reconstruction, better housing, better transportation and benign environment. There is gathering determination to counter the effects of harmful technological fall out and, more positively, to anticipate and avoid such fallout in the future. There is a widening effort to identify and mobilize the powers inherent in science and engineering qualitatively to enrich our society.

In our technological society is to be made to work and be humane, if we are to make headway in solving the horrendous problems which confront us, there must be continuing emphasis on these collective efforts to invent new ways, new programs, and new organizational arrangements whereby science and engineering, the arts, social sciences, and the humanities work in partnership and bring their resources sensitively to bear on the contemporary needs of our society. What I describe, then, is a kind of institution in which a constellation of collective efforts are invested with humanistic purposes.

Let us hope for a revival of humanism and a spirit of synthesis. Let us put new emphasis on engineering as a professional craft, requiring high skill, natural talent, deserving social recognition, distinctly different from the scientific professions as such. New stirings are appearing in this direction. I believe that engineers and engineering schools will play an important part in restoring the unity and central view point in the natural sciences.

ENGINEER AND THE SOCIETY

Certainly a large share of the blame for the slowness evident in tackling human problems, described earlier, must be laid on technology itself and on the engineer who has traditionally confined his interests all too narrowly to his technical speciality, and who is only beginning . to take his proper place in the mainstream of social activity. It seems to me that, more than any other group, the engineering profession must accept this new responsibility whole-heartedly.

Almost unthinkingly the scientist and the technologist have created this modern world. By eliminating distance the scientist has given a meaning to the concept of one world and reality to the concept of a single human family. By demonstrating that unlimited wealth can be created provided a base for it exists, he has invested humanity with the power to clear up all the slums on this earth. He has created something whose promise, whose scale the non-scientific and sometimes even the scientific mind barely comprehends. But after doing all this he turns his back, entrusting the task of world development to those who live and think in 'terms of an age of scarcity. Plato has said, 'Until philosophers are kings or the kings and princes of this world have the spirit and power of philosophy, and political greatness and wisdom meet in one, and those commoner natures who pursue either to the exclusion of the other are compelled to stand aside, cities will never rest, nay nor the human race.' This to my mind is the real need of the hour.

The world of the engineer can no longer be limited to the concerns of business and industry, or even to the traditional requirements in the field of public works. Along with the rest of society, the engineer is faced with the task of finding solutions to these pressing problems of modern life. Basically, many of these problems are engineering problems. To a large extent, their ultimate solutions will depend upon the willingness and the ability of the engineering community to provide society with the kind of help and advice that is needed to solve them.

It is evident that the engineer will be called upon more and more to play an increasingly active role in the solution of these complex social problems. He will have to cope not only with physical forces, as in the past, but with biological, social, economical and political forces. As a consequence, engineering education in the years ahead- as well as science education-will have to impart through knowledge of the many non-technical aspects of modern life. Just as our government has financed big science, it must now finance big engineering more and more for solving the national problems.

I wish to reiterate the widening role of the engineer and the potentially close relationship between him and the humanist.

विश्वास श्वासौ च विद्यायहस्ते ।
नीतिं च रीतिं विधाय नेत्रे ॥
कौशिल्य कलशं न गणपत्य लोके ।
सोऽविश्वकर्मा जयतां सुजातः ॥

The engineer's professional responsibility has never been so central to our society as it is today. I speak primarily of the engineer, who, in Ashby's phrase, 'views technology as inseparable from men and communities', I speak of the engineer who has achieved a mastery of his speciality but who,in addition, has the capacity and motivation to use and shape technology as a powerful humanistic instrument for enhancing the quality of our society as well as its material advance, for helping to solve the social problems of our time, and for directing technology toward aesthetic and moral objectives.

Therefore the new civilization that we are seeking is characterized by the extraordinary Development which the engineer can henceforth give to the power of men over nature. Lord Hinton of Bankside has said that 'if in a war, a nation has only one national aim, the success of its armed forces, certainly the first national aim in time of peace would be to ensure the success of this nation's industry,' and he adds, 'industry alone earns the money, and the internal, social and foreign policies depend on money.'

The future role of engineers in the exalting parts of the building of a new civilization is already essential today, and if it can only increase, it will become predominant. The power over the forces of nature is in fact more and more due to the will to organize the work of man, according to the scientific method, which allows the results of science to be multiplied prodigiously. Now the engineer is responsible for this 'factor of multiplication'.

We shall, therefore, not allow ourselves to be led astray by the finality of technique, or organizing, producing, being efficient, and we shall jealously preserve our joy of understanding by spreading it around us. This will require important reforms in our education, in our behaviour with regard to those around us, and surely also in the action of our associations.

Today our engineers are living up to the inspiration of the Society where one encounters their handiwork in every walk of life. They are producing the sinews of the country's economy, carrying the burden of implementation of the nation's Five-Year Plans, supplying the means of mobility and communication to the community, providing equipment, tools, structures and services for industry, building shelter for the teeming masses, providing and procuring water for agriculture, powering the wheels of industry for the defence and safety of the nation.

They have cheerfully and effectively taken the responsibility but lack the authority to produce spectacular results. They have in three Five-Year Plans helped to increase the industrial production by 150%, have doubled the carrying capacity of railways to over 200 million tons, augmented electric energy output fourfold, increased the roads by 80 percent, and brought the benefits of irrigation to 20 million hectares of There is however much headway yet to be made a self generating economy is established in the country.

The technological explosion requires engineers with even greater power and capacity for leadership. The engineer has now not only to be in the forefront for advancing knowledge and gradually but infallibly to change the way of life, but to lead and direct the country and command its respect. A turning point in the prosperity and advancement of the nation can be reached only when enlightened statesman realise the potential that has been lying dormant amongst Indian engineers, a potential which would make us one of the greatest in the community of nations. .

There is an immense necessity for the fusion of basic sciences technology, management and industrial practice for better economic progress in our country. The services of persons who command all the resources of knowledge in science, technology, management and industrial practice and the mobility of personnel from one type of activity to another will certainly provide an impetus for growth in large projects of national importance.

ENGINEER'S ROLE IN AGRICULTURE

Modern agriculture is more than plowing, planting, cultivating and harvesting. Today's agriculture includes many other industries — the manufacturers of the millions of rupees worth of farm machinery, power units, fertilizers and other 'inputs' the farmer buys each year. It includes the processors and packagers of the farmers' crops. It includes railroads, trucks and airplanes which transport lakhs of tons of produce to market each year.

The engineer is an integral and very important of the term of professionals which produces, processes, transports and markets, the ever-increasing amounts of food and fibre needed for the world's exploding populations.

While technological developments such as chemical fertilizers, pesticides, plant breeding, etc., have possible greatly increased crop yields, which is the engineer who has invented and developed machinery to prepare and till the soil and harvest these crops. It is the engineer who has designed the irrigation systems and great to provide the water for millions of acres of the world's irrigated agriculture. And It is the engineer who developed methods of storage, processing and transportation for the crops after harvest.

Engineers who do not consider themselves 'agricultural' engineers by the usual definition will be interested to know how their industries can be related to agriculture taking an example of their contribution to agriculture in the United States.

In the U. S. the petroleum industry sells 20% of its total production to the farmer, to operate his tractors, combines, and trucks. The rubber industry sells 20% of its production to the farmer for pneumatic tyres for these machines, and for their drives. The chemical industry sells 10% of its output to the farmer. This amounts to about $ 1.5 billion for fertilizers and $5 billion for pesticides annually. The automobile industry sells 15% of its total output to farmers. And 90% of the water collected behind dams is eventually used on farms. The civil chemical, electrical and mechanical engineer thus has a greater stake in agriculture. There is a group of engineers which is closer to the land than many of the above. These are the engineers who design the distribution systems for spreading irrigation water over the arid lands of Asia, Africa and the Americas. They are the engineers who design modern housing for livestock to provide environments conducive to efficient of feed and physical arrangements conducive to efficient use of human labour. They are the engineers whose spectacular achievements in the mechanization of the production and harvesting of crops for food and fibre have in less than 200 years increased the number people one farm worker can feed, from two to forty. These are the world's agricultural engineers.

Probably the most spectacular agricultural engineering achievements of today are being made in the field of mechanization of the production and harvesting of crops, and I would like to tell something of the research approach to these problems and some of the recent accomplishments.

For our first example, let us take the harvesting of deciduous trees: fruit-prunes, apples, cherries, peaches, cots, etc. Many attempts have been made to harvest these fruits from the trees faster than can be done by handpicking in to a basket, from a stepladder. The obvious approach is to shake the tree so that the ripe fruit falls, and stop the falling fruit in a padded catcher, or let the fruit fall to the ground and pick it up later with another machine. The problems are that the fruit ready harvest may not be the fruit that falls when the tree is shaken; the ripe fruit may be damaged as it falls through the tree branches below; it may be damaged when it hits the ground or the mechanical catcher; and the tree itself may be damaged by the shaking machine. The solution of these problems has taken the combined efforts of many agricultural engineers, food scientists, plant breeders economists, and plant pathologists.

And here is a general quality of agricultural engineers—they do and must work with biologists. They must from teams and partnerships with soil scientists, entomologists, plant breeders, agronomists, as well as with farmer producers. The biologist's knowledge must be added to the engineer's in order to cross-fertilize the latter and enable them to direct the powers of nature for the convenience of mankind.

The tomato harvester is the second and most recent example of a machine revolutionizing an industry. About 15 years ago two scientists of the California Agricultural Experiment Station agricultural engineer Copy Lorenzen and plant breeder Jack Hannah, were impressed by the problem California farmers had each fall in obtaining labour for handpicking in an area of approximately 125,000 acres of tomatoes. Each year the growers had to find around 40,000 persons who would go into the fields for the peak season a few weeks and do this harvesting. Lorenzen and Hannah started an on two fronts: Lorenzen would design a machine to harvest new variety of tomato, and Hannah would breed of variety of tomato that could be harvested by this undeveloped machine. Needless to say, these two men — the engineer and the biologist — had many discussions before they decided just what the new tomato and the new maachine should be in order to be compatible. They decided that the machine could not be a selective harvest; it could not pick ripe tomatoes and leave green ones, as did the human harvester, because of the tremendous cost and time that would be needed to develop such a machine. Rather they agreed on this two-way approach: Hannah developed a determinate tomato, one that ripened all at the same time. It would be of uniform size. It would release itself easily from the twine but still not drop off before it was in the harvester. It would have a skin able to stand the inevitable punching, dropping, sliding, and other mechanical action of the machine. It would have all the characteristics — acidity, water and solids content, etc. — needed for processing and storage. And finally, it would please the housewife and consumer with its flavour, colour and consistency. Lorenzen designed a machine that would harvest this tomato rapidly and efficiently, without damage to the fruit, and that could be manufactured at a profit by the farmer.

Thus the combined skills of agricultural engineers and biologists have wrapped up a package covering many fields of knowledge. Harvest costs can be almost cut in half. The need for much back breaking labour can be done away with. There will be cheaper and better food for all of us.

What is the future of engineers in agriculture? I think that engineers should be and will be the leaders in providing ways for the people of the world to become both better fed and happier than they are now. Agricultural mechanization has its most important future in the developing countries of the world, like ours where food is raised and harvested still mainly by hand. For such nations, 90% of whose people are occupied in farming, machines would provide a rapid means of liberating humans from a traditional bondage to the soil. People freed from the land may turn their energies to industrialization and ultimately to the creation of a better life for all. The engineer must provide the leadership for both these great problems-the production of food with a minimum of human labour, and the provision of jobs through industrialization for the people who are to leave the farms. The first of these jobs to solve is that of providing food; and the second, to provide for industrialization. I have faith that engineers can provide leadership for both as well as the knowledge, and the energy to accomplish both.

NUCLEAR ENERGY AND ITS IMPORTANCE IN MODERN SOCIETY

Many countries are now focussing their attention on the economics of nuclear energy and how the engineers cah influence their contribution to food production, desalination, agro-industrial complexes and similar future developments, by the application of nuclear energy.

Food and Agriculture

Notable advances reported from the application of atomic energy in food and agriculture, promoted by FAD includes the success of radiations induced mutants for better crops and a proof of the efficacy of the sterile insect method for combating damaging insects and pests. The use of radiation to improve characteristics for crops has now resulted in many new varieties being. made available to growers and superior crops covering millions of acres being grown throughout the world.

Waste Management

For the first time, man has faced the consequences of release of hazardous material from the atom to the environs which could affect posterity at some time hundreds and even thousands of years hence.

All the same, never has an industry shown such a preventive approach to the disposal of waste and the elimination of hazards as has the nuclear industry. From the beginning, it has been under tight governmental regulations, safety has been a major concern, each operation has been under careful inspection and control, and much research and development have been done to ensure safe waste management practices. Perhaps even more striking is the manner in which the industry has approached the moral implications of an operation which could affect generations in the future.

Nuclear Desalination

Another trend in our technology will be desalination. It can bring economic relief to society. The by-product of desalination, just as the by-products of nuclear plants is, however, a great worry. It is said that technology is perfect and we can go to corridors, but corridors are not at all known to us. It is our duty to see that these corridors are open to us but we should be cautious not fall to the lowermost stratum of the elevator stack.

Nuclear power is now being sought for use in desalination plants. Studies are in progress to expand the concept of linking the power to chemical industries, fertilizers, etc; under-soil irrigation directly from desalting plants which could economize on the use of water; the use of comparatively small plants to maintain the level of reservoirs during periodical dry periods; and develop breeder reactors to reduce costs.

Peaceful Nuclear Explosives

There has been worldwide interest in the use of nuclear explosives for peaceful purposes. If this becomes possible, such explosives could offer dramatic benefits to man.

In the fields of mining and civil engineering, the applications of nuclear explosives are concerned with creation of underground storage areas; extraction of minerals and petrochemicals; and construction of large civil works including geographical projects.

In the construction of large works, one can traverse a scale ranging from relative straightforward quarrying and ground breaking all the way to major geographical alternations, such as the building of harbours, and canals and the division of waterways. At the lower end it is clearly possible to fracture a considerable amount of rock rather inexpensively in order to make its removal easier, as might be desirable for railroad and highway cuts in mountainous areas. In such construction also, and particularly in building dams in isolated areas nuclear explosions can also be used to permit quarrying of broken rock, as for the production of concrete aggregate.

It requires little imagination to conceive a situation in dam construction where a cratering shot is employed both to move a considerable quantity of rock to the point where a stream is to be blocked, and to provide broken rock for concrete aggregate.

Major canals can be very expensive to construct by conventional means. Meanwhile, nuclear explosion technology has advanced and it is possible to predict the ability of a row of charges to create ditches. This technique could be used in canal building with a considerable savings in cost. With cratering type of nuclear explosion shots of large magnitude, 'instant' harbours could be created in locations where the rock floor of the sea is not at a great enough depth to permit docking of large vessels.

TECHNOLOGIST'S ROLE IN INTERNATIONAL COOPERATION

'Science and technology are very seldom spoken of as champions of freedom. Yet in our day, science and technology provide the most effective means of liberating the people of the less developed countries from their ancient and traditional servitudes of ignorance, illness, malnutrition and lack of adequate shelter and clothing. How free are the 900 million illiterates of this world who cannot read or write, to whom all of the intellectual and cultural heritage of mankind is closed off? How free are those hundreds of millions who are ill-clothed, ill-fed and shelterless, whose utter poverty leaves them bereft of hope and inspiration? How free are those whose life expectancy is so short, whose energy so weak debilitated that the effort required to create a be life seems impossible? Such has been the lot of many millions of people from ages past in the less developed countries. The present capabilities of modern science and technology however, make it possible to put an end to these inhuman servitudes and to create for man a material situation in which spiritual and human dignity can be a reality and not a travesty.

मताये बेवहा है दर्द व सोजे आरजूमंदी
मुकामे बंदगी देकर न ले शाने खुदा बंदी
—इकबाल

It has been said by a well known educationist 'Education is fundamental to everything and Education fits you for nothing, but prepares you for everything.'

The definition of Education in the words of Williams Wordsworth in lines written on Tintern Abbey:

" ..... when thy mind ....
Shall be a mansion for all lovely forms,
Thy memory be as a dwelling place
For all sweet sounds and harmonies ..... "

But, in this atomic age, more emphasis must be placed upon science, from the earliest years. I think our schools are often teaching on a level that does not challenge the student. We under-estimate the student. A story is told that comes from the U.S.A., of two youngsters in kindergarten, who were playing during recess. An aeroplane passed overhead, and one said to the other: 'Oh, B55', the other replied: 'No, you can tell a B55 by the angle of the wings', then the other said: 'It is not coming very fast'; and the other: 'No only 600 miles an hour, it has not broken the sound barrier yet'. Just then the school bell rang and one youngster turned to the other and exclaimed: 'Well, let's go in and count those damned beads.'

'The vision of the beautiful is really common to both sciences and the arts,' 'and both of them have a vital impact on each other, in the blossoming of creative activities either in one field or the other'. In actual practice we are trying to have in our present system of education, both educated scientists and uneducated scientists. That is something which has to be very much avoided. The neglect of the classics and the humanities in the education of the younger men in the advanced countries is a danger also to the countries belonging to the other civilizations in the East, which are now being termed under developed countries.

This responsibility of scientists and technologists as members of the human race, sharing a common heritage and linked in a common destiny with the rest of mankind is a force to be reckoned with. Science and technology also find their place in military defence and, unfortunately, offence. This places an added responsibility on scientists to assist their fellow scholars, especially the humanists, to find the way for man to live peacefully with his neighbours, using the material by-products of science for the material and cultural welfare of man living under the awful spectre of the misuse of the products of science for civilization's destruction.

Therefore the scientific community of the whole world must be more closely related. At the present time, the scientist in the developing countries is all too often cut off from the mainstream of thought, and it is thus extremely difficult for him to make a major contribution; for while the complexity and breadth of scientific knowledge require an ever-increasing degree of specilization, the very extent of this specialization at the same time demands increasing cross-fertilization between apparently unrelated disciplines. The creation of a world-wide scientific community would help to solve problems.

The knowledge of human behaviour, resulting from a long chain of scientific findings, has shed light on many intricate problems of existence, thereby liquidating deeply entrenched prejudices and myths which, for ages, have stood in the way of human progress. The great increase in the speed of means of communication and transportation has given reality to the conception of One World; but, at the same time, by bring nearer many countries and varieties of culture, which were until recently widely separated, has released new tensions and conflicts.

All people of the world must be linked together in a truely uncommon market of mankind — the market of the free exchange of experiences, cultures and ideas. Through this uncommon market, mass communication may prevent mass destruction.

TECHNOLOGIST'S CONTRIBUTION TOWARDS R EDUCATION

Illiteracy, it was pointed out, has the effect of insulating the minds of the people from the progressive influences of the written word. This means an absence of understanding of the physical and human environment and the prevalence of superstition. On the practical side, it leads to a lack of appreciation of the role of proper nutrition and sanitation, thereby undermining the health of the individual and the community. Inefficient and wasteful methods of farming prevail, and measures for the preservation of natural resources are not taken.

How then can formal education be brought to the teeming millions who are crying for it? Alongside the lamentable shortage of trained teachers and the lack of physical facilities, such as classrooms, teaching materials and suitable textbooks, there are also problems created by a multiplicity of languages — languages often insufficient to serve as a means for conveying the complex ideas of modern technology. Moreover, the shortage teachers, in the face of the phenomenal numbers of children to be educated, is a problem continuously aggravated by a large population increase.

Consequently, radio and television offer the best, and at times the only means of reaching large numbers of people through a comparatively small team of qualified personnel. A great deal of effort has already been put into studying the potentialities which these aids possess in teaching at all levels.

ELECTRONICS AND THE ENGINEER

Widespread use of solid-state electronics will be made in the field of communications (both for entertainment and for information) which will become global in scope through the effective use of cables and satellites. Such networks will have a profound impact on our educational system.

Electronics is now playing an important role in controlling our transportation systems, especially our airlines, but with the current developments we can see it being applied further to the control of automobile traffic.

Another area is that concerned with our health. Electronic systems are finding increasing use as aids for medical diagnosis and in medical treatment, and eventually will find wide application in the controlling of our bodily functions, such as with the heart pacer.

Electronics is finding increasing use in the control of industrial production. With the advances in the sensing of information, such as temperatures, pressure, flow, and the rapid processing of this information, and the ability to generate signals for control of the process, it becomes possible to solve many of the problems that arise in industrial production.

ADVANCES IN COMMUNICATION BY SATELLITES

Communication satellites represent the latest advance in modern telecommunications. They have created a communications revolution and are fundamentally changing world information patterns.

Today, the Communications Satellite Corporation (COMSAT) which acts as Manager for the International Telecommunications Satellite Consortium (INTELSAT) operates synchronous communication satellites over the Atlantic Ocean, the Indian Ocean and the Pacific. These satellites make communications possible directly between countries on a global coverage.

Accelerating technology, as exemplified by the satellite, has made it possible to achieve vast increases in communications capacity, quality, versatility and flexibility at substantially lower transocean rates. The major questions that face communication planners, therefore, are not essentially technical or economic. They are political, and they justify a break with traditional concepts and practices in international communications.

Another important feature of communications satellites is versatility. They are capable of transmitting information in all forms in telephone, telegraph, radio, television, data and facsimile. Moreover, the global series of satellites launched in 1968 carryall forms of communication simultaneously. No other means of transmission is able to do this, especially at such low cost.

There are now as many television sets in the world as there are telephones, and live international telecasts are becoming routine. Last year, some 400 million people in 14 countries on five continents simultaneously viewed a two-hour telecast that included President Johnson's meeting with Premier Kosygin in Glassboro, New Jersey.

And, closed circuit television holds great educational potential in the United States and other developed countries, especially when it is combined with computer and facsimile information storage and retrieval systems that make information available to students from central libraries, all at the push of a button.

The potential of closed circuit television in the developing countries can be even more dramatic. While many people ill these countries may not be able to read and write, they can hear and see and therefore they could be given training through television in the three R's, health, agriculture and vocational skills, thereby helping to lift world standards.

A group of prominent intern is has suggested a worldwide diagnostic communications centre. A service of this kind means that your own medical history including such things as television pictures of electrocardiograms, could be transmitted instantly wherever you needed medical aid. A demonstration of such service has already been conducted between the U. S. and Europe.

Weather charts and maps, based on meteorological satellites and other sources, have already been transmitted between countries in facsimile form via satellite. The faster such data can be transmitted accurately, the more effective become worldwide forecasts for airline operations, agriculture and other uses.

Never before have the global characteristics of science and technology held so many consequences for so many people. The day is not far when weather can be predicted weeks in advance. Advanced nations are now equipped to apply weather modification technology to the problems of developing countries. The experimental earth resources satellite will have the potential, among other things, to monitor water resources, measure the extent of snow coverage, determine timber growth and locate crop diseases and schools of fish. In another use of satellite technology, India and the United States are currently engaged in a joint experimental effort to bring educational television to Indian villages by satellite. Technology is rapidly giving man the ability to exploit the resources of the deep seabeds. A proposal made by the U.S.A. seeks to make these resources the common heritage of mankind. In a pioneering approach, it provides for an international regime to regulate exploitation beyond a depth of 200 meters. An expansion programme of technical assistance is already underway within the International Atomic Energy Agency so that the benefits of nuclear technology in medicine, agriculture, hydrology and industry can be made available to the developing world.

Apart from these, the post-Apollo programme of the U.S.A. are being focussed on the development, on a multilateral basis, of a new generation to re-usable space vehicles designed to make the exploration and use of space easier and more economical — in it goes a truly international endeavour to ensure' that space is not the exclusive preserve of only a few countries.

Looking at the progress we have achieved in the field of space and satellites during the last few years, there is no doubt that Thumba can do much more excellent things. It has already started single-stage rockets and is now planning three-stage rockets. Satellite communication has a unique place in our country. For instance with the help of satellites, we can telephone from place to another in almost no time.

POLLUTION — DARKNESS AMID THE BLAZING NOON

It has been said that what distinguishes man other animals is his ability to influence his environment. It could be said with equal truth that Man's distinguishing characteristic is that, unlike other animals, he fouls his own nest. We are apt to congratulate ourselves on the improvements we have achieved in such endeavours like the organization of refuse and sewage disposal and the purification of water supplies. We point with pride at the virtual disappearance of such killers as diphtheria, enteric fever, scarlet fever, whooping cough, typhus, small-pox and cholera. But we are liable to overlook or refuse to face the fact that in the same period we have been busily polluting our rivers and our atmosphere with all sorts of domestic and industrial waste products. So far as river and stream pollution is concerned, it may be argued that the effect on human health is negligible and that although detergent foam is unsightly, it is a problem only to those who have to reckon with it at sewage works. There are, however, the grim evidences to show that atmospheric pollution will be increasingly harmful. Those imbued with the spirit of laisse faire will point out that such ravages are rare; that the individual killer in the pollution has not been positively identified; that the various gaseous constituents are never in a state of equilibrium; and that it is pointless to use expensive methods of purifying waste discharges. This kind of thinking merely obscures the issue with another kind of fog — this time of words. The episodes and lethal effects of pollutions are serious enough in terms of waste of life and of man-hours, increase in morbidity and respiratory ailments, temperature inversions and production of noxious products, and heavy tolls through genetic effects.

Due to the unprecedented increase in the human race every country is proceeding with myriad development projects, great and small, which in the guise of irrigation and power scheme, land settlement plans reclamation schemes, timber and wood based industries, plantation of exotics and industrial and transportation systems is scarring the land, destroying both natural fauna and flora, the jungle and the pasture land. Despite well drawn conservation programmes, the opposite has, however, been the result. Immediate convenience and temporary benefits have obscured long-term disadvantages that would result from a vanishing wilderness. Destruction is going on a splendid nothing can be done about it except to write and record the danger to life that is accumulating on us.

Thus the problem of pollution of the air, the land and our streams is getting more severe each year, and solutions that are being attempted are obviously far from adequate. Our garbage is not properly disposed of trash is left lying around everywhere, and our roads and parks are dust laden and the whole atmosphere of the town and cities is polluted in many ways. Our sewage plants are overloaded and primitive, and very little experimentation is going on with new systems, while our streams are polluted with trash, sewage, chemicals and industrial processed waters.

Chancey Starr, Dean of Engineering at the University of California in Los Angeles, says that although many of our environmental pollution problems have known engineering solutions, the problems of economic readjustment, political jurisdiction and social behaviour, have been lurking as very large obstacles. As a specific illustration, the pollution of our water resources is completely avoidable by engineering systems now available; but interest in making the economic and political adjustments to apply these techniques has been very limited. In most case town fathers just do want to take the risk of trying new and expensive systems. No one would either, if his re-election hung on the failure of an engineering experiment.

Advanced nations are spending millions to probe the atmosphere of distant planets, while the air here on our earth remains polluted with dust and heat with which man cannot cope. Indeed, it is out good fortune that ships from other planets are not sampling our atmosphere — the conclusion might well be that life cannot possibly exist on earth. Finally, many of our, cities continue to exist with overcrowding, ghetto living, deteriorating buildings and slums that are a haven for pests, lack of open spaces, and conditions so miserable that both mind and body are withered. What values have we set for ourselves as men when some of us must live in such primitive conditions while others cruise the universe im-free, sterile space cabins.

The 'pollution' problem is no less an evil than war. We should do the same things again to mobilize the nation's whole efforts — of the government, industry, the public, scientists, engineers and businessmen — to combat and solve the menacing problems it creates.

There is no doubt in my mind that if we turn over our attention now to practical problems and are willing to wage a war against the deterioration in the quality of our lives — even for a short period, the advance we could achieve for humanity would be phenomenal. And ir would set us apart as a nation for all to follow a nation which is willing to seriously approach the problems of its citizens and find the solutions for them. To do so would not be a difficult task at all when we know that all our engineers and scientists are ever alive today to advancing knowledge and techniques.

ENGINEER AS A SOLDIER

Throughout man's history, development of his society has intimately depended on his military preparedness. The industrial revolution and the advances in science and technology have greatly influenced his military organizations, tactics and strategy. In fact, reversely, the most important and revolutionary advances is science and technology are made under the stress and strain of war to meet the demands of the Armed Forces in the fight for survival. It is now being increasingly realized that the military strength of a nation wholly rests on its technical strength, namely, the engineers, as it is they who contribute directly and indirectly to the solution of technical problems of modern wars, which in the ultimate analysis, are, for the most part, engineers-wars. To quote the memorable words of the late Lt. Gen. Sir Harold Williams, Past-President of the Institution: 'Every engineer who by his technical knowledge and skill, his industry and determination contributes to the development of India's industrial potential is contributing directly to her defence.'

Our Armed Forces have their special tasks to perform, but it is the solution to crucial engineering problems that will decide our success ultimately. Even advanced knowledge of the problems of a future war will be of very little help, if our engineers and industry are not defence-consciousness as a whole. They have to collaborate in a disciplined way to develop the equipment necessary for defence by effectively employing civilian resources at short notice.

Whatever the precise nature of engineering tasks, their urgency, scope and magnitude would inevitably impose a severe test on the entire engineering manpower and material resources of the country. The effectiveness of output will largely depend on the degree of mobility, disciplined approach and speed of execution on the part of the engineer to meet the challenges from whatever quarter they may come.

The engineer must be equally in readiness to cope with the escalating tasks stemming from sudden aggression, and expose and acclamatize himself to the uncommon and elevated altitudes, intense colds, burning deserts bleak and desolate forests and rugged mountain terrains to keep the wheels and weapons of the army going. It is a truism that in peace a nation has to prepare itself for war. Restive neighbours on our borders and an ominous unabated build-up of hostile forces on the rampage have forced the nation to make the abstracts a truism, an immediate and vital part of her national plan.

Our country has been a focal point of barbaric invasions for thousands of years, control of our homeland against hostile neighbours and unexpected attacks is decisively vital in view of its long border line, exposed geographic positions and vast economic responsibilities. It is no longer possible to maintain such control only by the action of professional soldiers. Because of undeveloped terrain on our borders and the severe climatic conditions prevailing in the areas, we should be prepared really for an 'engineers war' in case emergency arises. To activise security and live in peace politically, socially and economically, we require to build-up not only our defence strength but our technological strength in the most effective way. Technology is leaping beyond bounds. It cannot be put in a warehouse and stockpiled for future use. It is as highly volatile as man, and its transitory nature is the major factor that dictates its disciplined and efficient utilization by men who are responsible for it.

The profession of engineering is essentially a social institution offering an orderly way of life, not without elegance. The performance of public duty is not the whole of what makes a good (professional) life, there is also the pursuit of private excellence. And it is to ensure these ends that the engineer should be trained and disciplined in the soldier's way. He can then give much and take more to enrich the nation.

RURAL DEVELOPMENT

We are witnessing since the last two decades a tremendous social upheaval in our country and a social revolution is in progress. This revolution has tended to break the joint family and draw' out people from rural areas to urban areas in search of a living and higher standards of amenities and comforts. As men who are responsible for the creation of these, we must admit that we have done little. The rural population is migrating to the cities because it cannot make a livelihood in and around the villages, It cannot do so because the engineering required for agriculture and other rural pursuits has not been made available to the extent necessary. Engineering can help much not only in irrigation and water supply, but in the matter of earthmoving and agricultural implements and machines, dairy equipment, fertilizer projects, pest surveillance, etc.. Engineering can also help the villagers to remain in the countryside by bringing to them the amenities of civilization, namely, electric power, roads and better housing. Our battle as engineer-soldiers, therefore, really lies in villages where naked poverty continues to prevail.

Truly speaking, India lives in its villages, with as much as 80% of the population confined to villages, big and small. We are predominantly a rural-biased economy. Any plan for economic prosperity must, therefore, start at the grassroots, viz., at the village level.

In spite of an agriculture-based economy, the country had been passing through recurring phases of shortages in agricultural outputs both in foodgrains and commercial crops. The shortages had to be met through massive imports for which the country had to shell out huge sums in foreign exchange, thereby imposing additional burdens on the economy. It has now been realized that until and unless the country is able to secure self-sufficiency in agricultural foodgrains and commodities, the talk of any breakthrough in economic development would be hollow and unrealistic. We have to step up our food production to 160 million tonnes by 1980-81 for an expected papulation of 650 million as against the present production of 105 million tonnes, while the rate of growth should be roughly doubled. To achieve this, every village must have irrigation. Since large tracks of land have remained uncultivated, sample surveys should be undertaken. The biggest handicap in bringing more land under intensive cultivation is lack of irrigation water. And it is here that engineers must make an all-out effort to act quickly and conscientiously.

As members of the society, it is our duty to bridge the difference between the rich and the poor which has been the cause of all our troubles. Let us ask ourselves: have we gone to villages and have we done any social service? Why should the society recognize the doctor and not the engineer? The answer is obvious. We are not recognized because our contact with the society is not close and we do not spare time for social service. There are many villages, zilla parishads and municipalities which cannot afford to engage experts to get their services. We should go to their help and by that means win the recognition due to us. The Government has declared that 560 000 villages require re-orientation. The work required to be done consists of replanning, improvement of hygienic conditions, provision of water supply, schools and dispensaries and the like. Our Local Centres or a panel of engineers from the Institution membership should come forward to undertake these tasks. I am happy that our brother-engineers at Mysore, Gujarat, Maharashtra, Orissa, etc., have already been rendering excellent service in this behalf. The work being done by the members of the Institution at Ahmedabad in flood devasted Surat and Broach is praiseworthy. Many of the senior engineers there are voluntarily helping the villages and zilla parishads in building houses and digging wells.

NEED FOR INTER-DISCIPLINARY APPROACH

The traditional pattern of organization in our colleges of engineering has been based upon sub-division into subject matter such as civil, mechanical, electrical and chemical engineering. Departments of aeronautical or aero-space engineering are still in an infant stage and are more inter-disciplinary in character because they serve in industry of extremely wide diversification. The departmentalization of engineering colleges has been associated with firmly established undergraduate curricula carrying the same names and titles of degrees as the departments. This has contributed to perpetuation of rather sharp sub-divisions in the profession of engineering. Both the undergraduate student and the professional engineer have thought of themselves first as civil, mechanical, electrical or chemical engineers and only secondarily as engineers.

Step by step, engineering education at the undergraduate level due to the impact of science and mathematics has become more alike for mechanical, electrical, chemical and all other engineers. A common freshman year has been extended to common second and third years in several colleges of engineering. It is said that scientific knowledge doubles each decade. This explosion of knowledge necessarily results in longer exposure of engineering students to the study of science, and its close cousin, engineering science, before the opportunity can be grapsed for engineering specialization.

The side effects from greater uniformity of bachelor' degree curricula in engineering may well be a greatest unity of the engineering profession. Its members will all have passed through a bachelor's degree programme of engineering, without significant divergence due to specialization, and will thus become engineers first. Only secondarily will those who desire to specialize be titled mechanical, electrical or chemical engineers. It is possible that engineering education therefore may eventually bring unity to the profession of engineering in much the same way that the M.D. degree has held together the diverse specialities of the profession of medicine.

ENGINEER'S PACE WITH TECHNOLOGICAL EXPLOSION

एवं प्रवर्तितं चक्रं नानुवर्तयतीहयः
अघायुरिन्द्रियारामो मोघं पार्थ स जीवती ॥
गीता ३/१६

The final point of a curricular nature that I would like to discuss is the question of versatility needed in the training of persons to serve the enormously developing technology of our country. The problem today is the rapidity of change. Large companies have found that half of their production may come from products that were not being manufactured 10 years earlier. What has happened to the engineers they employed a decade ago? Evidently they too must have changed their interests and capacities to meet changing conditions, or else many have become obsolete. Undergraduate education in engineering should provide flexibility of mind and the desire for continuing education or individual study over the professional life time of the student. Each course and each curriculum must be designed on the basis of the transferability of the knowledge acquired by the student. Of what limited use to the 1975 engineer would be the knowledge he could have. acquired in college in 1960 concerning methods of concrete construction, vacuum tube manufacture or the assembly of reciprocating airplane engines? Because of newer inventions, such practical knowledge may have only a 10 or 15-year life and is most likely to be taught toward the end of that period.

The knowledge that has the highest degree of transferability from one engineering position to another is clearly the English language, mathematics, basic science, engineering science and an understanding of synthesis as the basis of engineering design. When this knowledge is combined with an understanding of people and of society the engineer can advance rather than regress with each technological breakthrough or invention. This view point if accepted fully would lead to some radical changes in both under-graduate and post-graduate engineering curricula. The presentation of engineering practice or technology should be restricted to purposes illustration and to the minimum background required as an input to the study of synthesis or design.

PUBLIC RELATIONS

We have been repeatedly hearing that men of science and technology will be kingpins of the economic and social transformation of India. Alas, there is a yawning gulf between pious statements and stark realities. Although engineers have been considered to be indispensable to the country's economic and social uplift, they have hardly any voice in policy making.

We engineers, conservative by nature, restrained in expression but precise in our thinking, have to realize the full implications or importance of public relations in a democracy. It is high time that we notice these realities and strengthen our public relations so as to comprehensively cover industrial employers, the Union and State Governments and the Press. Frankly, our conservatism in public relations has provided a fertile und for so many mushroom organizations which sometimes pretend that they talk on behalf of all the engineers in India.

Generally, we do not have poignant means for speech or writing. However, the time has come when these have to be cultivated. The engineer has to sell himself to the layman for whatever good things he proposes or does. It is the engineer's duty to wrest the technological leader ship in their own hands. Politicians are laymen in engineering and unless we guide them, things will go by default and all our good intentions will be wasted. It is, therefore, necessary for us to recognize and create an image for ourselves and develop and demonstrate strength of character that we can stand on our own. We have to clamour that we should have parity in administrative services, that we should not be put to a second place; and we should be given the position due to us in the society. We have to fight for the recognition of the good work done by us.

It is heartening that some change is noticeable now in the attitudes at higher levels and, I hope, in the near future, more technical men would be placed at the helm of enterprises dealing with technical subjects. Further, I hope that as most of our planning involves the spending of money on engineering projects, engineers should be associated with these planning bodies. These are days of democracy and unless we are present in the legislature and the law making bodies of the nation, our presence will not be felt. We might shout from various platforms, but it has limited value. Unless we are in legislature, our voice and our leadership will not be effective. It is strange that musicians and other professionals are honoured on the Republic Day but engineers are yet to find a prominent place in such honours' lists. I urge upon the Government to ensure that engineers are placed in their right positions and even a single voice from them should be good enough to guide the politicians to the proper channel.

THE INSTITUTION'S ROLE

The Institution has all along been trying to focus the needs of the profession and the society's responsibility in relation thereto and vice versa, by its actions in the various fields in which the Institution bears professional responsibilities, namely, communication, public under- standing, engineering education, professional guidance and technical re-generation. The Institution's professional concern for engineering education has ranged from subject matter to recognition of educational standards maintained by the universities. As a vital professional body, the Institution is also equally concerned in the professional guidance of its members, extending to them mature and unbiased assistance through senior members and specialists. The Local Centres have been doing most laudable work by offering career guidance and professional courses as a means of strengthening our professional bonds and ungrading our technical consciousness.

The Institution has very much realized that, in the context of penetrating new tools and techniques which form a new language, mere technical experience does not do very much to help better understanding. In order to meet the situation of obsolescence of engineering knowledge and skills, the Institution has taken the responsibility of arranging through its various Local Centres refresher courses and continuing education programmes. In fact, enlightened thinking of the various Division Boards and Engineering Groups have now been diverted towards devising better and more effective means of technical re-generation among the Institution's vast membership.

The Institution has deeply concerned itself with the vexing problem of increasing unemployent of qualified, capable and creative engineers in the country and has been continuously at work to stimulate action and cooperation from the nation's many fronts. With the fullest conviction that engineering bas an all-pervasive role in the country's future, the Institution has launched many comprehensive programmes not only to fight out the menacing enforced idleness of engineers and, secure for them suitable jobs but to create opportunities of 'selfemployment' as well, a bold experiment in self-reliance which had been little tried so far in the country.

Fully conscious that control and prevention of pollution calls for a national act, and that health js primarily a State subject, the Public Health Engineering Division and the Institution Council have already voiced their recommendations both to the Centre and the States for the immediate need for suitable water pollution control acts and establishment of River Control Boards to undertake the tasks of preserving better water environment, preventing pollution and restoring the cleanliness of rivers.

The Institution is represented on governing bodies of almost all universities, educational institutions and national laboratories and innumerable government organizations, such as, ISI, NBO, CSIR. The Institution has very much kept in view that successful technological development of the nation will' only be ensured by the co-ordinated efforts of all the functional cadres of the government and the national policies regarding status and recognition of engineers and their salary structures. To bring them in tune with the overall social and economic growth envisaged, the Institution has set up an Action Committee to pursue these matters. In short, the Institution has always been laying down the ground roots for the direction in which it should move to be more active, more dynamic and more outreaching.

ॐ नमस्ते सते ते जगत्कारणाय
नमस्ते चिते सव लोकाश्रयाय ।
नमोऽद्वैततत्त्वाय मुक्तिप्रदाय
नमो ब्रह्मणे व्यापिने शाश्वताय ।।

Shri J G Bodhe—a Brief Profile

1. Shri J. G. Bodhe, B.E., F.I. Struct E., F.I.A.A., F.I.V., M.Soc. C.E., F. ASCE., M.I. Cons. E. (India), M.I.E., an eminent engineer, architect and consultant who is internationally known for his achievements In civil and prestressed concrete engineering has been elected President of the Institution of Engineers (India) for 1971-72. He will take over this high office from the retiring President, Lt.-Gen. R. A. Loomba, F.I.C.E., F.I.S.I., M.I.E., at the 51st Annual Convention to be held at Chandigarh during February 11-17,1971. The Convention will be inaugurated by the President of India Shri V. V. Giri .

2. Shri Bodhe is outstandingly familiar in the profession of engineering where he is loved and esteemed for his technical eminence, great perspective and vision, and his gentle Qualities of head and heart. With a distinguished engineering career and professional attainments, he is a leading Consulting Engineer having a large consultative practice not only in India but even In other countries abroad. He has been responsible for many outstanding civil engineering projects. He has to his credit many specialist constructions, some of the more prominent among them being the Jawaharlal Nehru Bridge at Ahmedabad, textile mills, cement factories, sugar factories and largo water towers throughout India and East Africa. He is Internationally known for his Invaluable proposal regarding the suspension bridge project In Bombay which is now under the active consideration of the authorities.

3. Shrl Bodhe's devoted association with the Institution of Engineers (India), of which he is a member for well over 34 years, has been remarkably memorable. He has not only concerned himself continuously with the affairs of the Institution by his untiring efforts and Intimate role in the Institution's. many-sided deliberations but has contributed to its welfare and progress in many directions including the field of know-ledge where his masterly writing ability and editorial excellence have brought forth numerous outstanding engineering and technical papers to the Institution and other International publications. He was recipient of the Jawaharlal Nehru Memorial Gold Medal for his paper on 'Bio-Engineering' and the K. F. Antia Memorial Prize for his paper on 'Town Planning in Ancient India' during the Institution's Annual Conventions held at Jaipur ' in 1968 and at Calcutta in 1970, respectively.

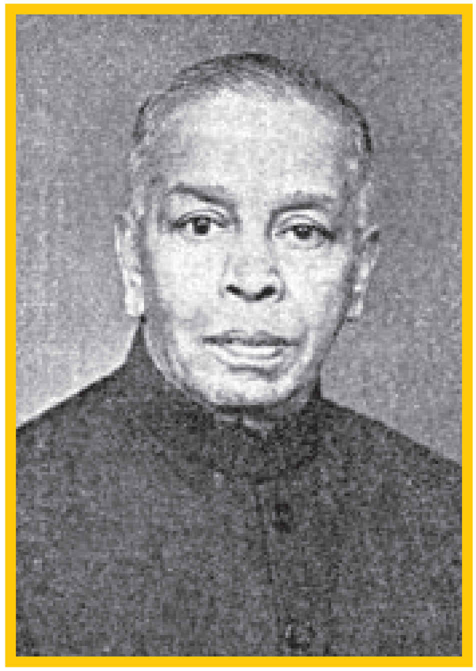
4. Shri Bodhe has been playing an equally leading part in the field of technical education in the country. He is a member of the Board of Technical Education. Maharashtra; the All-India Council of Technical Education; the Council B. M. Polytechnic, Bombay, and the Engineering College, Sangli. He has headed many technical committees appointed by the Government and is an important member of several Government committees, such as the Bombay Repair and Reconstruction Board and the Advisory Council of the Housing Board of Maharashtra.

5. Apart from his multifarious technical activities, Shri Bodhe's interests have spread over the commercial and Industrial fields too. He is the President of the Board of Trustees of the Bombay Port Trust and is the Vice-President of the Maharashtra Chamber of Commerce. He is also Vice- President of the Asiatic Society, Bombay, the premier and oldest learned and cultural Institution in the country. He is an executive member of the Children Aid Society and a member of the Metropolitan Regional Planning Board of Maharashtra.

6. In the background of his academic and technical distinctions and contributions, Shri Bodhe has received distinct recognition from several professional societies and learned institution both within and outside the country. He is a member of the Association of Consulting Engineers, India, and a Fellow of the Institution of Valuers (India). He is a member of the Indian Roads Congress and is connected with various technical committees of the Indian Standards Institutions both within and outside the country. He is a Prestressed Concrete, a member of the Executive Council of the International Association of Bridge and Structural Engineering, and a member of the Institution of Structural Engineers as well as their representative in India. He is a Fellow of the American Society of Civil Engineers and their representative in India. He is also a Fellow-Member of the Society of Civil Engineer, Franco.

7. He has achieved distinction in other Quarters too. He Is a Justice of the Peace and an Honorary Presidency Magistrate. He has Innate love for music. specially for classical music in which field he conducted an Indian music school for several years. He is an accomplished orator and an active social worker.

8. Shri Bodhe's election as President brings to us a dynamic leader and a selfless worker through whom the Institution and, the engineering profession in the country seek purpose, direction and lead.



Shri M Ganapati
President 1973-74

Presidential Address

YOUR EXCELLENCY,

HON'BLE CHIEF MINISTER,

SHRI BODHE, DISTINGUISHED GUESTS, BROTHER ENGINEERS,

LADIES AND GENTLEMEN:

1. I have very great pleasure in welcoming you all to the 53rd Annual Convention of the Institution of Engineers (India), I consider it a signal honour to our Institution that the President of India should have graciously consented to inaugurate this Convention in spite of the demands on his time, I take this opportunity of particularly conveying our grateful thanks to him.

2. We are also deeply indebted to our Chief Minister. Thiru M Karunanidhi, for being with us today to preside over this morning's inaugural function and to the very distinguished guests who have gathered here this morning to attend this Convention and give us encouragement.

3. To me it is a great honour that my colleagues in the Council of the Institution have thought fit to elect me as their President for the year 1973-74. I look upon it as a measure of confidence they have reposed in me to steer the affairs of the Institution during this year. I am indeed very grateful to each and everyone of the Council Members for having conferred on me this great honour.

4. To achieve distinction in one's own work and merit the conferment of a title in the pre-

Independence days and a high decoration in the post-Independence days as far back as in August 1954, has been comparatively easy as a result of conscientious hard work and devotion to duty but to be elected as the President of this mighty Institution of ours has been a much more formidable task and has demanded of me years of patient for the Institution as a Council Member. I therefore look upon this honour as a mark of appreciation of my work for the Institution by the Council Members and would like to thank them all once again for the honour they have done me.

5. My election as the President of the Institution for this year will also be conferring this signal honour on a Railway Engineer after 23 years. The Railways with nearly 4500 engineers belonging to different disciplines of engineering can thus be proud that one of their engineers is now at the helm of affairs of this great Institution. Even though there are about 4500 engineers on the Railways belonging to different disciplines, the number of engineers who are members of this Institution is very small indeed, possibly because Railway Engineers have not developed the inclination to devote some time to the Institution nor have they acquired adequate opportunities to take part in the executive activities of the Institution. The Railway Engineers generally seem to be content to live in isolation as they are a big community themselves. Often times the question is asked "What do we get by joining the Institution of Engineers?" My answer to this question is that we get what we put in plus a lot more. The objects of the Institution are very clearly laid down being mainly the advancement of engineering and engineering science, to facilitate the exchange of information and ideas on those subjects amongst members, promote high standards in the practice of the profession and to uphold the concept of professional contacts amongst its corporate members as well as to disseminate engineering knowledge for promoting social achievements with productive economy through the best use of natural and human resources. Every engineer has a duty to perform to ensure these laudable objects and the railway engineer is no exception. Not only the railway engineer benefits by his joining the Institution but also the country as well as the comit of engineers. I would therefore, appeal to one and all of the vast number of railway engineers to join this Institution in large number and make their presence felt.

6. Our Institution, which was started in 1920 and later obtained a Royal Charter in 1935 with a small membership of 1500, has now on its Roll a strength of more than 70000 consisting of Fellows, Members, Associate Members and Students. Comprising also as it does all the seven major disciplines such as — Civil Engineering, Mechanical Engineering, Electrical Engineering, Telecommunication Engineering, Public Health Engineering, Chemical Engineering, and Mining & Metallurgical Engineering . Ours is an all-embracing Institution with headquarters at Calcutta and Centres located in all the 18 headquarters of States as well as in 30 numbers of Sub-Centres attached to the Local Centres.

7. By all accounts it is the biggest and most representative institution of engineers of all disciplines all over India with its assets in the shape of buildings of its own valued at more than Rs 10 millions (excluding the cost of land), in almost all the Local Centres as well as in many of the Sub-Centres also and with big libraries of engineering books at all these places. Endowed as it is with these assets and with this background, this Institution offers all the facilities required for the advancement of engineering knowledge and for the promotion of the study of engineering for enabling scientific and economic development in our vast country, and to give the Government of India, the local Governments, and public bodies facilities for ascertaining the views of eminent and highly experienced engineers as regards matters affecting engineering practice. It is for the lacs and lacs of engineers all over the country to avail of all these facilities by becoming members of the Institution in larger numbers and promote efficiency and just and honourable dealing in the practice of engineering for which a Code of Ethics has been drawn up and enjoined on all its corporate members.

8. We have in our country five other institutions representing the disciplines of

telecommunication engineering, chemical engineering, mining & metallurgical engineering and aeronautical engineering. While one would have desired that all such similarly placed engineering institutions merge with the biggest of them all and thus be able to function as one united body of engineers sharing the benefits, and voicing their demands as one body, we are aiming in the first instance to bring them together as a Federation which I hope will soon take shape.

9.1 In keeping with one of the main objects of the Institution, i.e., dissemination of engineering knowledge, the Institution has since long been conducting examinations twice a year for the Studentship of the Institution and parts A & B of Associate Membership examination. The passing of these two parts of the Associate Membership examination which enables the candidates to become Associate Members, is treated as equal to passing any university degree examination in engineering, and it is also accepted by the Union Public Service Commission s well as State Government as equivalent to having passed a degree course.

9.2 This facility enables a very large number of students aspiring to become engineers who either cannot gain admission to various engineering colleges in the country or who prefer to earn and learn by undergoing part-time courses in engineering studies offered by several institutions in the country, to appear for the AMIE examinations conducted by the Institution.

9.3 We have thus on our Roll a very large number of students who strive hard to pass our AMIE examinations and become engineers. To facilitate their studies Student Chapters designed for the advancement of the technical activities of the students and development of their social and professional contacts, have been established at all the Local Centres of the Institution. Members of the Institution take part in these activities and it is my fervent appeal to all members of the Institution to encourage the activities of the Student Chapters as much as possible.

10. It is customary for the President-Elect of the Institution en the occasion of the Annual Convention to deal in his address with problems concerning the discipline or profession with which he has been connected during his service.

11. As fat as I am concerned, I have taken a degree in Mechanical and Electrical Engineering and, after having specialized ill hydroelectric engineering for a little more than two years, I joined the Indian Railway Service of Engineers concerned with all the civil engineering work on the Railways and served the Railways for the best part of 30 years during which period I held charge of three major projects, viz, The Dufferin Bridge regirdering at Kashi, The Chittaranjan Loco Works Project and the Integral Coach Factory at Madras. I was also on deputation twice to take charge of two very mighty projects-the Kandla Port Project in 1953-55 as its Development Commissioner, and the Rourkela Steel Project as its Resident Director from early 1958 to end of 1960.

12. I cannot therefore say that I was exclusively attached to Railway Engineering work and would hence include in the scope of my Address not only railway engineering practice but also engineering practice in other spheres. At the outset, living as we do in the space age with flights to the Moon being an accomplished fact, I am not prepared to take a pessimistic view of our own state of development in the field of Science and Technology. While we have a long way to go to catch up with the upto date advancements in various fields of engineering, I consider that we have the resources, talent, and requisite manpower to make rapid strides in all fields to be able to get abreast with the other nations of the world in due course consistent with the availability of funds for which Government are making redoubled efforts Plan after Plan to mop up all resources and increase the tempo of Plan spending in geometrical progression.

13. RAILWAYS

13.1 The Indian Railways with a capital at charge of over Rs. 300 crores, a route length of nearly 60 000 km, employment potential of about 141akh men and annual budget of over Rs. 1 050 crores are the largest single undertaking of the Government of India. Managed as I it is by railway men at the highest level consisting of members in the Railway Board in charge of Civil Engineering, Mechanical Engineering, Transportation, Staff and Finance portfolios, I can in my humble opinion confidently say that the Railway Ministry is the best run Ministry in spite of occasional ruffle caused by either an accident here or an accident there or even an unusual incident. The simple reason for such efficiency in management is the fact that every Department of the Railway is in charge of a railway man belonging to the department at the Board level and the entire organization is tuned up to meet the challenges posed by problems arising from time to time in the various departments. The Chairman of the Railway Board not only co-ordinates the work of all the other members but also holds charges of the department to which he normally belongs. In this manner the direction and control of all railway work managed by General Managers of Railways at the Zonal level, is in the hands of men who have risen from the departments, who possess detailed knowledge of the working in the departments as well as abundant experience of the work of the various departments.

13.2 This is quite different to generalists holding charge of various portfolios stage by stage as in many other departments of the Government of India. The Communications Department have in recent years copied the model of the Railway Ministry in setting up a Post & Telegraphs Board for the direction and control of the entire work of the Ministry at the highest level. There can be no doubt that this change in the Communications cations Ministry has made for a distinct improvement over the previous set up.

13.3 I would here take this opportunity of advocationg the setting up of similar boards, big or small, of technical men for managing the affairs of all technically oriented. Ministeries like the Transport Ministry, the Work, Housing and Supplies Ministry, the Iron & Steel including Mines & Metals Ministry, the Irrigation and Power Ministry and even the Industries Ministry where technical knowledge and experience over a long period of years will be of immense value on the part of those entrusted with the management of these Ministries at the secretariat level. There is no doubt whatsoever that there will be a more realistic appraisal of the intricacies of the problems posed to the secretariat if, in the case of all these Ministries, they are manned at the highest level by technocrats who have worked in the Departments concerned for a period of years both in office and outside and who by virtue of their intimate knowledge and experience in the Departments will be able to contribute their utmost for the able and efficient management of the depart concerned.

13.4 It is very gratifying to note that a recent press note stated that Government have accepted the desirablity of posting technocrats at the highest level in the technically oriented ministries provided the right type of men with adequate knowledge and experience are available. It is hoped that this intention of the Government will soon be implemented.

13.5 The Railways which celebrated their Centenary in April 1952 are nearly 120 years old now and represent a well-knit organization at all levels and except for some marginal improvements from time to time, the pattern of management is well set to be able to administer the Railways efficiently. Complaints of inefficiency or irregularities do come from the public from time to time and these are looked into promptly with a view to set them right to the utmost extent possible. Composed as it is of an enormous organization consisting of ever so many men from the lowest to the highest levels, the human element cannot but prevail in the operation and management of this vast organisation. Nevertheless the Railways have to keep a constant vigil on the performance of their men in all the departments and more particularly in the operation and maintenance departments with a view to ensure maximum efficiency and maximum service to the public at minimum cost.

13.6 Being one of the biggest undertakings of the Government of India in the Transport and Communication Section, the Railways absorb quite a big percentage of the planned outlay of Rs. 3237 crores under the head Transport and Communications' for the Fourth Five-Years Plan from 1969-74. In addition to the Rs 1050 crores allotted in the Plan outlay, the Railways themselves provided for an additional Rs 525 crores from the Depreciation Fund towards their development programme for the Fourth Five-Year Plan making in all a total of Rs 1575 crores. Taking the vastness of the railway system in our sub-continent and the prevailing costs of labour, materials and equipment, this sum would hardly be sufficient to provide for all the development programmes which are urgently needed but we can only plan the development programme consistent with the availability of funds. Apart from expenditure on rolling stock, track renewal and line capacity works which take away a major chunk of the total outlay, new lines electrification and metropolitan transport get only about Rs 215 crores during the Plan period. One would have liked more funds set apart for electrification consistent with the availability of electricity as the operation cost of electrified sections are estimated to be 60% cheaper than for steam traction.

13.7 Further, electrification provides the much needed additional capacity without having to take recourse to doubling. Dieselization also helps to reduce operating by about 30% and would need to be considered for more and more sections of railways far away from collieries like the southern and western regions of our country. No doubt these major issues are receiving the best consideration of the railway administration.

13.8 Another important subject agitating the minds of railway men and the travelling public alike is the programme of conversion of metre gauge lines into board gauge, to eliminate delay in transit and damage to goods particularly at the transhipment points. Here again availability of funds limits the programme to only 750 km during the Plan period as a part of a long term-plan. As regards new lines, the Plan provided only for a limited programme in addition to making provision for work on 1 022 km of new lines in progress.

13.9 Metropolitan development in the four big cities — Calcutta, Bombay, Delhi and Madras — has been under consideraion for almost a decade now. The problem is getting more and more urgent year after year on account of the vast increase in population and in road and rail transport in and around the cities. It is therefore gratifying to know that a sum of Rs 50 crores has been allotted in the Fourth Plan for this purpose and that this is likely to be increased to enable the development work by way of construction of underground railways in these cities, being taken in hand without further delays. As a matter of fact very recently, a big sum has been alloted for expenditure during this Fourth Plan by the Calutta Metropolitan Development Authority.

13.10 Competition by road transport has been on the increase year after year with longer and better roads and more and more road transport vehicles pressed into service. These matters have also been receiving the urgent consideration of railways who have evolved suitable means of competing with road transport after taking into consideration that road transport has come to stay for certain kinds of traffic such as short distance traffic etc. Unfortunately, however, long distance traffic from the major cities is also being weaned away from railways for which the railways are to find ways and means of attracting clients to use the railways instead of road transport. A great attraction of the road transport traffic is the house-to-house service it offers without unnecessary handling and consequent damage and costs. Measures like container service which are being developed by the railways will certainly go a long way to secure this traffic back again for the railways. Nevertheless concerted attempts have to be made by the railway to sell their service to the public in greater and greater measure.

13.11 There has been one another aspect of railway working which has received the approbation of the Government, viz, self-sufficiency in almost all its needs including locomotives, coaches, wagons, cranes and other workshop equipment, etc.

13.12 The drive for self-sufficiency which began more than two decades ago with the setting up of the Chittaranjan Locomotive Works followed by the Integral Coach Factory and later by the

Diesel Loco Works at Varanasi and the additions and alterations to their numerous workshops has almost been fulfilled and except for very odd items of small value there is hardly any import so far as railways are concerned. Considering the magnitude of the railway system, this indeed is a very great achievement, not only making the railways self-reliant but saving considerable sums of foreign exchange.

13.13 One other very important aspect of railway working is the establishment of a Research, Development and Standards Organisation of its own at Lucknow which has been developed considerably to meet the requirements of all the Engineering Departments-Civil, Mechanical, Electrical, Signalling & Telecommunications, etc. It would perhaps make for more efficiency if research works on Transportation and Commercial Department work of the Railways is not only centralized but enlarged in its scope and content.

13.14 Every subject, small or big, requiring detailed research is undertaken by this organization and designs and drawings for all the works carried out by the railways beyond the capacity of individual railway organisations, is also done centrally at this place. In pre-Independence days railways had engaged a reputed firm of foreign consulting engineers. With the establishment of this Research, Development and Standards Organisation nearly three decades ago, the railways have done away with foreign consultancy services. This is a very proud achievement indeed.

14. TRANSPORT / COMMUNICATIONS

PORTS

14.1 As regards major ports and minor ports a traffic of about 55 million tonnes handled by these ports in 1968-69 is expected to go up to 77 million tonnes by 1973-74. A good portion of this increase will be on account of bulk commodities like petroleum products, iron ore and fertilizers (including raw materials) and hence it will be necessary to create special facilities to handle such traffic. Outer harbours are to be created at Madras and at Vizag to deal with such traffic. A new harbour is being built at Mangalore and Tuticorin. The Haldia dock system is also being pushed through to completion in the Fourth Plan. The oil dock in Bombay is also being expanded to deal with heavier traffic. The total cost of major ports development programme in the central sector is expected to be Rs 280 erores of which the ports themselves will find Rs 100 crores.

14.2 A satellite port at Nheva Sheva across Bombay and an oil terminal at Cochin are also programmed for construction. Port facilities are being developed in Andaman and Nicobar Islands, Laccadives and a few other places like Porbandar, Mirya Bay and Cuddalore, etc.

14.3 In this connection I would like to point out that all drawings and designs of the various new schemes under the Ministry of Transport are not being handled entirely by Indian engineers unlike the Railways who have a Research Designs and Standards Organisation for dealing with all such design and drawing work. In this decade, quite a large number of port construction work is being undertaken and the opportunity that is available now for extensive work in the preparation of drawings and designs for such work will not be available later on. It becomes all the more necessary therefore that a full-fledged research and development organization is created immediately in the Ministry of Transport with a view to encourage Indian participation in all these items of complicated design and drawing work and thereby avoiding recourse to foreign consultants and the inevitable loss of foreign currency. The utilization of the services of Indian consultants in this field in preference to foreign consultants deserves far more encouragement with a view to conserve knowledge and experience apart from any other consideration.

15. ROADS

15.1 Despite substantial progress made in road development over the last 20 years, the road system has still large deficiencies. The national highway system alone has about 400 km of missing road links and 17 missing major bridges. Of the total length of 24 000 km of National highways about two-thirds have single lane width. In the state road systems also, besides inadequate _ road length, the existing roads in many areas have substandard surfaces, narrow width and weak bridges. Many economically backward regions and hilly areas have poor communications. A large number of villages still lack road links with market towns and with one another. In metropolitan cities, the development of the road system has fallen far behind the glowing requirements of traffic.

15.2 With a view to make improvement in all the above spheres, a provision of Rs 418 crores has been made during the Fourth Plan and a further provision of Rs 453 crores has been made for road development programmes in States and Union Territories where the length of surfaced roads will increase from about 325 000 km at the end of 1968-69 to about 385 000 km by 1974.

16. ROAD TRANSPORT

16.1 Goods traffic by road transport is expected to increase from 40000 million tonne-kilometres in 1968-69 to about 84000 million tonne-kilometres in 1973-74. The passenger traffic is expected to increase from about 98000 million passenger-kilometres in 1968-69 to about 140000 million passenger kilometres in 1973-74.

16.2 It is expected that the number of trucks on the road will need to be increased from about 301000 in 1968-69 to about 470000 at the end of 1973-74 while buses will probably increase from about 85000 to about 115000 during the same period. Commercial vehicles are also expected to go up from 35 000 in 1968-69 to 85 000 by 1973-74.

17. COMMUNICATIONS

17.1 The Plan outlay for development of communications is Rs 520 crores most of which is for telecommunications absorbing Rs 466 crores.

17.2 The number of telephones will be increased by about 760000 in all from the 1.1 million numbers now. The telephone factory at Bangalore is expected to be expanded and a new factory for the manufacture of long distance transmission equipment is proposed to be set up at Naini. Broadcasting will also be expanded with the provision of Rs 40 crores.

17.3 Electronics and telecommunication engineering are making very rapid advancements and the Plan outlay may require to be stepped up considerably to keep pace with modern developments in this very interesting field of engineering.

18. IRRIGATION AND POWER

18.1 On the irrigation and power side, our country is one of the foremost in the practice of irrigation methods and in the utilization of all its available waters in the huge rivers traversing the country. We cannot, however, say that we have utilized all the potential for irrigation by an integrated use and efficient management of surface and ground water resources. Extension of irrigation particularly to areas which are relatively deficient in assured rainfall as well as irrigation is very much needed. Programmes of minor irrigation with rural electrification schemes have been dovetailed in order to energise clusters of wells or tubewells.

18.2 Unfortunately, however, a certain amount of time lag exists between the creation of irrigation potential and its utilisation. This has to be reduced further by more intensive propaganda. Ground water resources have to be developed extensively in order to cope up with the need for more and more lands to be brought under cultivation.

18.3 An outlay on irrigation of nearly Rs 1470 crores has been made in the Fourth Five-Year Plan of which about Rs 955 crores is for major and medium schemes and about Rs 515 crores is for minor schemes. With all this provision for irrigation projects, about 4.8 million hectares are likely to be brought under cultivation; 4.7 million hectares from continuing schemes and 0.1 million hectares from new schemes. This will still leave nearly 30 million hectares to be brought under cultivation in the future. It would therefore be seen that there is still a long long way to go to reach the full potential for irrigation in our vast country.

18.4 Enormous quantities of water flow into the sea during the monsoon months inspite of all the dams and other irrigation works which have been constructed so far. Talk of connecting the Ganga/Godavari/Krishna/Cauvery and other rivers in the south has been raised since sometime. It is merely remaining as a dream of the future. This multi-purpose project is very much essential for ensuring that the enormous waste of flood waters through all these mighty rivers is avoided and the water conserved for more extensive irrigation. The project for connecting all these rivers might cost thousands of cores of rupees but detailed investigation for finalisation of the programme with a view to take up the work in stages over a period of years is very desirable. Our country is noted for the talent it possesses in this field of engineering and it should not be difficult to find all engineers required for this investigation from our own country instead of having to import foreign talent for this purpose except to a very limited extent if at all necessary.

18.5 Government are seized with the proposal and it is hoped that before long this mighty project with any modification which may be called for in the light of detailed investigations, which has been a dream for several years will start taking fruition. Incidentally it will provide employment for thousands of engineers all over the country.

18.6 Flood control and soil conservation is another very serious problem. We have seen during the monsoon of 1971 how extensive the flood damage was in Uttar Pradesh, Bihar, Bengal and Orissa, on account of sustained floods in the Ganga and other rivers in the region over a period of more than two months. Enormous devastation of cultivated lands and damage to property was caused by the unprecedented floods. A time has come when floods of this nature should be fully controlled. Schemes in respect of all these need to be formulated in an integrated manner.

18.7 Out of a total area of 16 million hectares liable for floods some six million hectares have been afforded reasonable protection by such measures as construction of embankments, drainage channels and town and village protection schemes. The provision of about Rs 133 crores in the Fourth Plan for flood control will afford protection to an additional 1.5 million hectares leaving another 8 million hectares and more to be thus protected in the future.

18.8 Soil conservation measures aimed at protecting storage reservoirs of dams from excessive flow of silt and sediment from the catchment areas are also very essential. An outlay of Rs 27 crores for this project in the Fourth Plan has been made.

18.9 As regards power generation, by 1970 a capacity for developing about 14.5 million kW had been established. Though at the beginning of the Fourth Plan the power position was reasonably satisfactory, shortages still exist in some areas and has got aggravated in the immediate past. There is a cry for more and more power for industries and agriculture but in the absence of adequate availability, all that is being done is the enforcement of power cuts.

18.10 With the increase in population and the need to have more lands to be cultivated and more industries to be set lip. we have to think of raising the power generation programme considerably. An outlay of nearly Rs 25000 crores has been provided for in the Fourth Plan providing for nearly Rs 200 crores for new schemes, over Rs 1100 crores for continuing schemes, about Rs 700 crores for transmission and distribution and about Rs 450 crores for rural electrification.

18.11 During the Fourth Plan, the States would be able to add 6.94 million kW to their installed capacity. Major hydel projects such as Beas (Dehar), Yamuna, Ramganga, Ukai, Subarnarekha, Sharavathi, Idikki, Balimela and large thermal stations at Santaldih, Kothagudam, Nasik, Koradi, Dhuvaran and Ulkai will go into operation during the Plan period. The new schemes for which provision has been made in the State Plans are yet to be identified.

18.12 Power requirements of deficit areas are proposed to be met by transmitting surplus energy from the adjoining States.

18.13 In this connection emphasis has rightly been laid on inter-State and inter-regional lines so that the power system in each region can be operated on an integrated basis. It is hoped that regional grids and the establishement of centrally loaded despatching stations in each region will soon be achieved.

18.14 Atomic power generation has also taken root in our country with the establishment of one station at Tarapur and two other stations under construction — one at Ranapratapsagar in Rajasthan and the other in Kalpakkam in Tamil Nadu, More are envisaged to be taken up for construction in the Fourth Plan.

19. INDUSTRY AND MINERALS

19.1 There is vast scope for development in our country in the field of Industry and Minerals. Considerable work has already been done in the first three Plans and the four annual Plans following them in setting up a number of heavy industries such as steel, heavy electricals, heavy engineering, fertilizers, etc but much more still requires to be done. The prospect of improvement in the employment situation also hinges on a rapid increase in non-farm employment opportunities which in turn depend on the tempo, nature and rate of industrialisation. One of the considerations in deciding the planning of industrial development is to create or increase capacity to produce the goods for which the country is largely depending on import now and achieve as quickly as possible self-sufficiency. Another consideration is to disperse industrial development around small towns in rural areas and a third consideration is to avoid what is known as 'technological unemployment.' In keeping with these principles the planned investments in organized industry and mining for the period 1969-74 is Rs 5300 crores — Rs 3 050 crores in public sector and Rs 2250 crores in the private sector. The major share of the public sector industrial outlay is meant for completing projects on hand while new projects are planned only in high priority industries like fertilizers, pesticides, petro-chemicals, non-ferrous metals and development of iron ore, pyrites and rock phosphate resources. This includes completion of the Bokaro Steel Project as well as the expansion of the Bhilai Steel Project and three new Steel Projects — one in Salem, one in Visakhapatnam and one in Hospet area which have been planned for commencement of work during the Fourth Plan. When these new steel plants are completed during the Fifth Plan we should be meeting the demand for steel almost entirely though such demand will be growing from year to year along with the developing economy of the country. By the end of the Fourth Plan, these should be producing nearly seven million tonnes of finished steel and two million tonnes of pig iron.

19.2 It is indeed very fortunate that the Steel Ministry and Hindustan Steel Ltd., thought of setting up a Central Engineering and Design Bureau as early as in 1959, when the three giant steel plants at Rourkela, Bhilai and Durgapur were under construction.

19.3 This design bureau which started in a small way with barely 100 engineers has in the last 13 years and more, developed itself into a huge organization with more than 500 engineers doing research, development and standards work almost exactly on the lines of the Research, Development and Standards Organisation of the Railways.

19.4 Not only do they undertake to do all drawing and design works in connection with additions and alterations to the existing steel plants including major expansion schemes, but they are constantly keeping in touch with modern developments in steel making all over the world to incorporate all new developments in our steel plants, with a view to improve their efficiency of working and bring about maximum output.

19.5 This body is now expected to become autonomous and place itself at the service of all steel plants in the public sector ofwhicb three are already working, one i at Bokaro in various stages of completion and three more at salem, Visakhapatnam and Hospet are in the planning stages.

19.6 It may be a stupendous task for a Central Organisation like this to undertake to do all planning work for the major steel plants but with the help of established consulting engineers in this field, it is well within the range of possibility for such a Central Organisation to / take care of all planning and design works as well as research work connected with the steel plants.

19.7 As regards non-ferrous metals, the Aluminium Industry is being expanded to produce about 220000 tonnes by 1973-74. The existing production of 10 000 tonnes of copper will be stepped up to 16 500 tonnes in Bihar and a further 31 000 tonnes in Khetri, Rajasthan. The Zawar Mines near Udaipur has to be geared up to produce 18000 tonnes of Zinc per annum and will be further increased up to 36 000 tonnes before the end of the Fourth Plan. Another plant at Alwaye in the private sector which produces zinc from imported concentrates is also expected to be expanded to produce about 20 000 tonnes per annum during the Fourth Plan. Geological survey work which has already been expanded considerably, would perhaps need more intensification.

19.8 On the engineering side the Heavy Electricals and Bharat Heavy Electricals who are doing a wonderful piece of work in manufacturing all the country's requirements of steam turbine generators, hydro-turbine generators and power boilers, electric motors, transformers as well as switchgears, capacitors, etc., will all be tuned up for optimum production. Expansion is also envisaged in machine tool production, transport and communication equipment and agricultural machinery. Shipbuilding capacity also is being expanded to produce about 80000 DWT per annum at the end of the Fourth Plan. A Second Ship Yard is being located at Cochin at a cost of Rs, 45 crores for building ships of size 66 000 DWT.

19.9 In regard to fertilizers about Rs. 260 crores have been provided in the public sector for new fertilizer plants and to reach a minimum capacity and production target of three million tonnes and 2.5 million tonnes nitrogen by the end of the Fourth Plan. In so far as phosphatic fertilizers are concerned a minimum capacity of 1.2 million tonnes and production of 0.9 million tonnes are envisaged during 1973-74. Increased production of petro-chemicals, petroleum refining, coal, lignite iron ore and mineral oil, all equally provided for.

19.10 Optimum utilization of capacity, particularly in the Heavy Engineering Complex at Ranchi and similarly placed industrial establishments elsewhere, is a problem requiring to be looked into immediately, to ensure an adequate return on the capital invested and that no plan capacity lies idle.

19.11 Research and development work not only in regard to each and every public sector undertaking, but in regard to each and every industry in the country, is of vital importance. Unfortunately, however, the importance of such research and development works in every project and industry is not fully recognized, as it does not pay rich dividends immediately. But looking at its efficacy from the long term point of view, there is no doubt whatsoever that research and development work will lead to continuous improvement in technique and quality of production and will ultimately pay rich dividends. In Western countries a good percentage of the total expediture on industries goes to research and development works and I do not see why we should not follow this wholesome practice in our country too.

19.12 Major research centres established in the Public Sector like the Central Mechanical Engineering Researh Institute at Durgapur, Central Roads Research Institution at New Delhi and the Central Buildings Research Institutes at Roorkee, Research and Development Organition attached to the Heavy Electricals, Aero Dynamic Research Institute at Bangalore, Cement Research Institute at New Delhi, Structural Engineering Research Centre and other such Public Sector Research Institutions, are doing very good work, and can be fully utilized not only by the Government agencies but private agencies as well. In addition, however, it will be worth while for each and every industry to have its own research centre to deal with the problems peculiar to itself. Only this way can a nation deal with the problems peculiar to itself. Only this way can a nation prosper. It is understood that Government will soon ensure that all major industries establish their own research and development organization. This will certainly help not only in increasing employment opportunities, but in the utilisation of our country's talent for the pursuit of yet more knowledge in the various industrial establishments in our country.

19.13 In this connection mention has also to be made about consultancy services in the country. With the setting up of such consultancy services in the public sector followed suit by big industrial establishments setting up their own consultancy services, the scope for the individual consulting engineer or firm of consulting engineers has got considerably reduced. The monoply which the Government wants to avoid in industry will soon be established in such consultancy services, adding soon to unemployment and also leaving no scope for retired and highly experienced engineers to continue to give advice to various parties on engineering matters. Apart from individuals being affected in this matter, the country will lose the knowledge and experience of a whole lot of engineers which it can ill afford.

19.14 Even if co-operatives of experienced engineers are formed,consultancy services in the Public Sector and under the aegis of major private sector undertakings will prove to be very difficult competitors when any work offers in the consultancy field.

19.15 Government are taking some steps to enroll consultancy services for utilization as and when required but nohing tangible seems to have come out of it so far as experienced engineers are concerned. The matter will therefore need further active consideration in the interests of the utilisation of the services of such eminent and experienced engineers in the best interests of our developing economy.

20.URBAN DEVELOPMENT, HOUSING AND WATER SUPPLY

20.1 The rapidity with which urbanization takes place can be understood from the fact that the urban population was 79 million in 1961 and will be 158 million in 1981. Towns with a population of 50 000 and above are expected to be increased from 250 in 1961 to 536 in 1981. Cities like Calcutta and Bombay are already overgrown the task is not only one of preventing further growth of population but also of decongestion or dispersal of population. In respect of other cities, careful future planning has to be undertaken to avoid the ills experienced elsewhere. Calcutta and its neighbourhood is receiving very special attention to provide for the abnormal increase in the congestion for moving road and rail traffic and also for the inadequacy of the water supply, sewerage and drainage, roads, slum clearance, housing and urban development. Likewise the cities of Bombay, Delhi and Madras are also receiving attention and while a Metropolitan Development Authority has been created for Calcutta, the Railways have created a new organization for Bombay and Madras to deal with the proposed underground railway systems in these two places.

20.2 A provision for Rs. 407 crores has been made for water supply and sanitation schemes. For providing safe drinking water in rural areas priority is given with a provision of Rs. 125 crores. Much of this is proposed to be use d in acute scarcity areas.

20.3 Schemes for exploration and exploitation of ground water resources which have received greater attention in almost all the States also include such exploitation in hard and rocky areas with the help of the high speed drilling rigs provided by the UNICEF. Water supply schemes in metropolitan areas are being planned as far as possible along with sewerage and drainage schemes. Discharge of wastes and effluents from industrial plants and sewerage in water resources has assumed greater proportions and Central legislation is being thought of to prevent pollution of water resources. In this connection mention can be made of the good work being done by the Bangalore Water Supply and Sewerage in ensuring adequate supplies of drinking water to the growing population of greater Bangalore and a similar Board set up for bringing in Cauvery waters to Madras over a 230 km, precast prestressed concrete pipeline 5 ft. 6 in. in diameter. These and similar such schemes concerning adequate water supply to big cities need urgent consideration and all the encouragement which can be given to them by State and Central Governments.

20.4 Housing is another problem which is of an enormous magnitude and cannot therefore be satisfactorily met within a few Five-Year Plans. It will take several Five Year Plans before the slums in big cities like Bombay, Calcutta, Delhi and Madras are removed and replaced by modest housing accommodation for the lower income group of society. Schemes in the housing sector therefore cover only a small portion of the total effort. Public Sector undertakings like Railways, Posts & Telegraphs, Defence, Heavy Industries — like steel and electrical industries — provide for substantial expenditure on the housing of their staff. The private sector also provides major share to the investment on housing. All these will amount to Rs. 2140 crores in the Fourth Plan which provides for an expenditure of about Rs, 237 crores including provision by the States and Union Territories of about Rs. 190 crores.

20.5 So far as village housing is concerned the essential task will be to get appropriate layouts made for the growing villages, provide basic amenities such as water and sanitation facilities and to stimulate private building activity. Encouragement, of course, will be given to the co-operative effort.

21. PROJECTS PLANNING AND PROCESSING

21.1 When we deal with more than Rs. 16000 crores of expenditure on projects during the Fourth Plan period and perhaps Rs. 35 to 40000 crores of during the Fifth Plan period, the problems connected with the planning and processing of various projects included in this enormous outlay, assume very great importance. Proper planning and execution within the prescribed time limit and within the estimated cost will save huge sums of money — anything upto 25%. Poor planning and dealys in execution of work will not only cost quite a lot of money but will also delay the commissioning of the project whether dealing with engineering work or industry and thereby add to the losses. It is in this context that the utmost care is necessary on the part of the planners to devote as much time as possible on the proper planning and preparation of estimates of various projects before they are sanctioned and put into execution. Hasty planning invariably involves mistakes and omissions which have later to be incorporated as additions and alterations to the scope of the projects involving additional costs which often times go upto 50% more than the original estimated cost.

21.2 Apart from haste caused by insufficient time allowed to the engineers in planning the projects and preparing estimates, one major cause for poor planning is the lack of suitable qualified and experienced men for doing such planning and preparation of estimates before the projects are sanctioned.

21.3 Now, after 20 years of planned project works, we have no dearth of experienced engineers. It is only a question of making a correct selection of most suitable engineers without vested interests creeping in. Incompetent and unsuitable men in top position go for foreign collaboration which at the present stage of our development is not at all necessary except in very rare cases. One cannot ignore in this connection the example of Japan where indigenous talent is exploited to the fullest extent not only to copy foreign know-how when absolutely essential but even improve upon it every time.

21.4 What is therefore of primary importance is that the selection of engineers to be entrusted with the preparation of the project report and estimate of costs, must be beyond any question involving vested interests and must only be based on qualification, experience and suitability.

21.5 There is no half way house in regard to this matter either in the public sector or in the private sector. Only then can we make the best use of available funds and ensure that we do not keep on adding and altering the scope of projects and increasing the estimated costs by big percentages.

21.6 For the execution of projects, it is equally important that only the best men are selected and posted. Incompetent and inefficient men at the top only conduce to waste of public money and delay in the execution.

21.7 Assessment of progress is another very important work which is to be done both at the project level and by independent authorities manned by the best available men, regardless of any consideration other than merit and suitability.

22. TECHNICAL EDUCATION

22.1 The present annual admission capacity of technical institutions is 25 000 students at the degree level and 48 600 students at the diploma level. The facilities available for engineering education are considered adequate to meet the demands of engineering personnel in the Fourth and Fifth Plans. What is necessary however is to pay greater attention to the improvement of quality and the standards of technical education. A high level committee has gone into this question recently and it is hoped that the recommendations of this committee would be implemented soon.

22.2 The programme for improvement of technical education would include pre-service and in-service training and training in industry of teachers as well, re-organization of diploma courses to enable the students to fit into the industry immediately after completion of studies and expansion and improvement of post-graduate engineering studies and research. It has been proposed to open up centres of advanced study in aeronautics at Bombay, in material science at Kharagpur and in electronics and automation in Bangalore. Part-time courses for degree and diploma are also expected to be improved.

23. UNEMPLOYMENT AMONGST ENGINEERS

23.1 In the last year or two owing to considerable unemployment amongst engineers and diploma holders, it was felt that there was a surfeit of engineers and diploma holders from the various institutions set up for the purpose in the last two decades. A great deal of frustration had taken place in the minds of students who had passed out of these institutions and admissions to the large number of institutions started falling down considerably during the last two or three years.

23.2 The position, however, has got steadied after the announcement of the details of the Fourth Plan amounting to nearly Rs 25000 crores of which engineering services and industries will alone consume more than Rs 16000 crores, nearly 66.7% of the total outlay. This has given a fillip to engineering works all over the country and it is hoped that before long unemployment amongst engineers and diploma holders will get considerably reduced.

23.3 With preparatory work for the Fifth Plan providing an outlay of more than Rs. 51165 crores to be taken in hand soon, followed by the enormous Fifth Plan projects, there cannot any longer be dearth of employment for qualified technical personnel. The main thing, however, is for such technical personnel to deserve employment opportunities and to make good not only so far as they themselves are concerned but contribute their best for the country's uplift. The Fifth Plan vides for about Rs. 11500 crores towards labour-oriented schemes, which will also mean employment of a proportionate number of engineers. This will go a long way in reducing unemployment generally and amongst engineers also if not altogether eradicate such unemployment.

23.4 Actually this problem of unemployment amongst engineers has in the last two or three years assumed considerable proportions and has agitated the minds of the persons involved as well as the Government and various bodies like our Institution. The matter has been gone into thoroughly in all its aspects and various remedies had been suggested such as apprenticeship in factories and industries in the Public and Private self-employment in a co-operative manner, more and more employment in rural areas and the opening up of engineering projects all over the country in connection with the Fourth Plan. The last item has materialised now but progress in the matter of self-employment an employment in rural areas is still taking time to materialize.

23.5 Government have done their best in encourageing self-employment and to advance loans through state banks to interested parties who can furnish proof of their genuine effort in setting up small industries or doing engineering business.

23.6 Members of the Institution of Engineers can do a great service to the country if such engineers who can spare the time make it a point to guide young engineers in setting up industries and in seeking self-employment. Industries likewise must encourage young engineers by offering them employment in a large way after necessary tests for their aptitude and efficiency.

23.7 Employment in rural areas, Panchayats and Municipal bodies will also go a long way to reduce unemployment and will incidentally provide the necessary amenities in rural areas. Here a sense of patriotism and devotion to duty is necessary on the part of our young engineers even as qualified doctors opt for services in rural areas to improve the health of the rural population.

23.8 With the population of nearly 530 million growing at the rate of about 2.5% per annum, unemployment in our country will pose a perpetual problem, unless every man and woman realizes the need for fuller utilization of man-power as in the Western countries as well as Japan, where prosperity follows fuller utilization of such man-power. Government on their part have considerable importance to this problem and have provided for labour-intensive schemes like construction roads minor irrigation, soil conservation, rural electrification, dairy development, village and small industries and housing and urban development. This alone is not sufficient. A drive on the part of each and every individual man and woman old and young is necessary as in Japan to get self-employed by taking resort to cottages industries to supply the needs of the major industries in the area.

23.9 Development of ancillary industries around the major industries has also to be resorted to more extensively so as to disperse industry for one thing and also find employment for another.

23.10 Only herein lies the solution for our nation to the top like the very prosperous sister nation to the east. Ours is a land of plenty with enormous natural resources still remaining to be exploited, vast man-power and agreeable climatic conditions throughout the year. There is no reason why we should not rise to the occasion with a very high sense of patriotism, and create the wherewithal, with which everyone can be fed, clothed and provided with shelter and all other amenities of life. It lies in us to create the prosperity from out of nature's bounty and enjoy the fruits thereof. The Prime Minister and the Government are showing us the way for achieving scoialistic pattern of life and it is for the nation to follow the directive principles and implement the politices laid down for reaching this goal of plenty for all in the speediest time possible.

STATUS OF ENGINEERS VIS-A-VIS GENERALISTS

24.1 The status of engineers vis-a-vis generalists has still not been solved satisfactorily. Engineers are the nation builders and their work is by no means less than the work of administrators and generalists.

24.2 Nearly two-third of each Five Year Plan expenditure relates to engineering works and engineers who are the architects of the nation have to deliver the goods and their role assumes ever so much more importance which cannot be denied.

24.3 To forget them and give them only secondary importance compared to administrators and generalists, is to deny them their rightful place in society. The Prime Minister has assured engineers that their role is of primary importance and second to none and that every step will be taken to put them in their rightful place. Unfortunately, however, these assurances have not been fully implemented yet.

24.4 For several years now, generalists and administors are here and there being placed in charge of major engineering projects giving the engineers a subsidiary role which results in considerable frustration and lack of initiative. The projects also suffer delays on account of lack of confidence on the part of the non-technical administrators, resulting in endless committees and meetings before decisions on vital issues can be reached.

24.5 It is gratifying to note that Government have recognized the need for a change in the policy and that engineers and technologists should generally be found to man the top posts for technically oriented projects.

24.6 It has also been represented that technically oriented ministries should also be manned by engineers and technologists of adequate experience, even as the Railway and Communication Ministries are functioning. Any explanation that the engineers lack adequate management experience is unfounded, as the engineers from the very start of their career gain experience in management. Refresher courses in up-to-date management techniques are also available for selected engineers, It cannot, therefore, be said that in modern times engineers do not acquire sufficient experience in management techniques. The Government have accepted this policy in principle that engineers and technologists should be seconded not only to the technically oriented major projects, but to top posts at the secretariat level as well. It is hoped that in the near future this policy will be implemented to remove a long standing grievance of engineers and technologists.

24.7 It is often said that nothing is more resented than the egregious class snobbery of the amateurish civil servants, who instead of constituting an elite of function, constitute an elite of status and at the same time it is also said that the professionals and technologists tend to be too much of a mere technician not strong even in the theory of his special field and so incapable of reaching the highest level of efficiency in his work. In the modern context of things and in the vast developing countries like ours, both these views represent two extremes and do not represent the position as it exists today. The country today is not starved of engineers of administrative ability and it is not therefore necessary to deny them their rightful status in the top management both of major projects and at the secretariat levels so far as technically oriented ministries are concerned.

24.8 I can most emphatically say that this way lies the most efficient path for controlling the enormous expenditure of the spending ministries like the Railways, Transport and Communication, Works, Housing and Supply, Iron and Steel and Heavy Industries, Mines and Metals, Irrigation and Power, etc.

24.9 It is my devout plea to the Government and to the Prime Minister that engineers and technologists must be given their rightful status to be able to give their best in the service of the nation. On behalf of the vast number of engineers in the country, I can state here and now that they will under all circumstances be unflinching in their determination to stand behind the Government in the furthering of the Plan projects envisaged in the Fourth Plan and the enormous Fifth Plan now being finalized with the utmost skill, ability and devotion to duty.

24.10 Engineers are second to none in their patriotism for the country. All that they have been asking for is a just consideration of their dignity and status on a par with any other service of similar importance. They are the Vishvakarmas of the country and are responsible for making life worth living in the construction of their homes for people to live and in providing the roads, water supply, drainage and other amenities as well as in the operation and maintenance of the industries big and small with which consumable goods, iron and steel and machinery small and heavy are manufactured and also in providing them with the power and irrigation facilities for the growing of more and more food and in fact in doing every thing for the good of man. Who can deny him his status in society on a par with any other service however important it may be.

25. THE EXPERT AND POLITICS

25.1 Engineers in modern days have yet another role to play and that in a new field—the field of politics.

25.2 Time was when experts in the field of science, technology and engineering did not care to get into the legislatures for two reasons: firstly, they were fewer in number and were absorbed in their own work and could not find time to spend four or five months attending legislatures either in the States or at the Centre; and secondly, under the then British Government they could not make any useful contribution to the debates in those legislatures as the administrative policies were generally pre-determined to suit the interests of the foreign government more than those of the country. Since Independence, however, the Government is now entirely responsible to the electorate and the candidates chosen by the electorate to represent them in the State legislatures as well as in the Parliament, have a right to freely voice their opinions in the legislatures.

25.3 What is more important to remember is the fact that colossal sums of money running into tens f thousands of crores of rupees are being set apart for each of the Five-Year Plan periods for various projects in the spending ministries referred to previously. The Fourth Plan allotment towards such projects amounts to nearly Rs 16000 crores and nearly Rs 40000 crores in the Fifth Plan. To control the expenditure of such enormous sums of money at the level of the Parliament and at the State legislatures, it will certainly be advantageous to have knowledgeable and experienced engineers and technologists also elected or nominated to these forums. I would therefore make a fervent appeal to the Government and to the Prime Minister to nominate a few engineers to the Rajya Sabha at the Centre and also request the States to similarly nominate a few engineers and technologists to the Upper Houses in State legislatures wherever they exist.

25.4 I am here assuring the Government that the nomination of even a few engineers and technologists would greatly help the Government in voicing informed and expert opinion on the floor of the Houses of legislatures about all matters connected with the enormous expenditure on the Plan Projects instead of facing criticism based on common place rum ours. They can also render most useful service in the various Committees of Parliament like the Public Accounts Committee, Estimates Committee, Public Sector Undertakings Committee, etc.

25.5 In the changing order of things in our country, with sweeping 'land reforms' contemplated, increasing tempo of industrialization, and every increasing expenditure on plan projects for exploiting the vast natural resources of our country, to bring more and more prosperity to the people, the number of experts in the field of science, technology, engineering and medicine is increasing many fold. They will be a force to reckon with in any system of elections to legislatures; nor can they be brushed aside as specilaists unsuited or unwanted in the highest echelons of Government. They are as much members of the body politic as anyone else and can certainly render a good account of themselves in any position in the administration or Government of the country past prejudices against such 'experts' are now out of tune.

25.6 Objection had been raised in some quarters for the appointment of experts as ministers. If a legal expert is required to be in charge of the Law Ministry, why should anyone grudge experts in science and technology duly elected to Parliament being in charge of portfolios which their qualifications and experience justify? They will be better able to guide and direct the Secretariat officials as well as the heads of the departments.

25.7 The English administrative saying that 'Experts must be kept on tap and not on top' has no relevance to the present-day trends. It is at best a one-time prejudice still lingering. The Lord Fulton Committee have fully vindicated the need for even-handed justice to be dealt to engineers and technologists. In a developing economy like ours, we have to depend on experts in the field of science, technology, engineering and medicine to a much greater extent than we ever did. Not only will they be on top of their profession, but in the interests of the taxpayer they may also have to be in top positions III the Government if the tax-payers money is to be best utilized for tbeir real good, avoiding waste through incompetence and ineffciency at all levels.

25.8 . It is no exaggeration to say that in the present-day spending spree, the tax-payers will be the gainers hundreds of crores of rupees if only we could have knowledgeable experts as ministers and secretaries in spending ministries, who by cutting across red tape and routine and by intimate knowledge of the subjects they have to deal with, can take right decisions at the right moment and see to it that the departments under them are manned by able, efficient and honest men of the right calibre, with a view to implementing their decisions quickly and also ensuring the utmost economy and speed in their work.

26. SUCCESSFUL ENGINEER

26.1 Finally, I would like to quote passage, defining successful terms:

26.2 The qualifications for achieving success in engineering are intellectual and moral honesty, courage independence of thought, fairness, good sense, sound judgement, perseverance, resourcefulness, ingenuity, orderliness, application, accuracy and endurance. An engineer should have ability to observe, to deduce, correlate cause and effect, and to apply the principles discovered.

26.3 Dealing with men, he should have the ability to co-operate, to organise, to analyse situations and conditions, to formulate problems, and to direct the effort of others. He should know to inform, convince and win confidence by skilful and right use of facts. He should alert, ready to learn, open-minded but not credulous. He must be able to assemble facts, to investigate thoroughly, to discriminate clearly between assumption and proven knowledge.

26.4 He should be a man of faith, one who perceives both difficulties and ways to surmount them. He should not only know mathematics and mechanics, but should be trained in methods of thought based on these fundamental branches of learning. He should have extensive knowledge of the sciences and other branches of learning, besides knowing intensively those things which concern his specialities. He must be a student throughout his career and keep abreast of human progress.

26.5 A famous statesman and one-time Cabinet Minister stated 'Well, if we could only get engineers of this type in India, there could be no difficulty in giving them not only all the public works of the country to be done, but the whole Government of India, lock, stock and barrel'.

26.6 It might appear that the attributes mentioned above for a successful engineer are ideological in the main, but I can state here that any conscientious, hard working and honest engineer who is passionately devoted to his work can verify for himself that he satisfies almost every of the attributes referred to herein.

26.7 It is also said of all successful engineers that they should carry on with their good work undeterred by any consideration of reward even as the Divine Gospal Geetha teaches us. Fame and a niche in the temple of history must come as a shadow behind the substance. If we run directly-after fame, the shadow, we shall fail miserably. What we should aim at is work and quality of achievement for the good of others. The engineer is just another high class machine in the chain of tools that is used to produce construction. This tool must be a first-class tool and never think of itself.

Shri M Ganapati—a Brief Profile

1. Shri M Ganapati, B.E., M.E.(Hon.), F.I.E., Padma Bhushan, an outstanding railway engineer, engineering administrator and planner of eminence, who is well-known for his achievements in great national projects, such as, The Integral Coach Factory, Perambur, Madras, Kandla Port, The Chittaranjan Locomotive Works, Chittaranjan. The Rourkela Steel Plant, etc. has been elected the President of the Institution of Engineers (India) for the term 1972-73. He will take over this high office from the retiring President, Shri J. G. Bodhe, B.E., F.I. Struct E.(Lon) F.I.A.A.(Lon). F.I.V., M.Soc.C.E. (Franco), F. ASCE(USA), M.I. Cons. E. (India), F.I.E. (India), during the 53rd Annual Convention of the Institution which will be held at Madras during February 15-20, 1973. The Convention will be inaugurated by the President of India, Shri V. V. Giri.

1. Shri M Ganapati, (born in November 1903) took the, M E (Hans) Diploma of the Government of Madras and tile B E Degree of the Madras University in April 1925. After serving in the Tata Power Company, Bombay, for about two years, he joined the Indian Railway Service of Engineers in March, 1928, as a result of a competitive examination. He specialised mostly in bridge work and project works on the East Indian Railway, from Calcutta to Delhi between the years 1928 and 1948.

2. Between 1945 and 1947 he completed the regirdering of the Dufferin Bridge across tile River Ganga at Varanasi. This most intricate and complicated work involved the scrapping of the single line Bridge consisting of 7 spans of 350 ft each and 9 spans of 110 ft each and in its place construct a double line bridge for two railway lines with an independent overhead road way. There were more than 50 trains on the single line section over the bridge and traffic conditions demanded that not a, single train could be stopped. Tho work of rebuilding the bridge under traffic therefore resulted in n most complicated scheme. In less than two years, new pier caps to accommodate the double line bridge was constructed and tho now bridge was built with amazing speed and precision.

3. Soon after, Shri Ganapati was called upon to take charge of the Chittaranjan Locomotive works Project as Engineer-in- Chief of the Project, which was completed by April 1951, whereupon he was posted to Madras for building the Integral Coach Factory Project. Half-way through this project, he was called upon by the then Transport Minister, tile late Shri Lalbahadur Shastri, to take charge of the Kandla Port Project as its Development Commissioner, as this work which had been started in August 1949, was languishing for nearly four years, without the main harbour work being started. Shri Ganapati took charge in April 1953 and by September 1955, the main Port work had been completed and he was transferred soon after to the Western Railway, Bombay, as its General Manager.

4. Shri Ganapati, re-organised this railway system into Divisional system from the previous regional system and carried out a largo number of plan projects of tho Railway, including tho re-building of Church Gate Station, in record time providing for a seven storeyed building for office accommodation also. The main station premises were completed with amazing speed within one working season, so as not to inconvenience more than 5 lakhs commuters per day, who use the Western Railway Sub-urban lines.

5. In May 1958, Shri Ganapati was called upon to take over the Rourkela Steel Project as its Resident Director at the instance of tile then Prime Minister, the late Sri Pandit Jawaharlal Nehru, as this mighty project was getting delayed and required a dynamic person to invigorate the pace of construction. More than 95 per cent of the work of the Rourkela Steel Plant was completed by October 1960, when Shri Ganapati retired. After retirement Shri Ganapati took to Consulting Engineer work and continuous to assist a largo number of project.

6. Shri Ganapati won the Railway Board Gold Medal and the Viceroy's Prize for his Institution Papers.

7. In recognition of his outstanding ability he was awarded the title of Rao Bahadur in January 1943, which he surrendered in August 1947. In August 1954, he was one of the first few Engineers of the country, who were decorated with the "Padma Bhushan".

Dr Jai Krishna

President 1974-75

Presidential Address

RESPECTED UP-RASHTRAPATI JI,

MY DISTINGUISHED PREDECESSOR, SHRI GANAPATI,

MEMBERS OF THE INSTITUTION OF ENGINEERS, LADIES AND GENTLEMEN,

I am very grateful to the members of the Council for the great honour they have done me by electing me as the President of the Institution of Engineers (India) for year. I assure them and through them the entire engineering fraternity of the country, that I shall strive to serve the Institution to the best of my ability, but what I am able to achieve will depend directly on the cooperate and support of the members of the Council, members of the Institution and the profession at large and I hope this cooperation and support will be forthcoming in abundant measure, I also thank my predecessor, Shri Ganapati, for the excellent form in which he is handing this office to me, I wish to assure him that it will be endeavour to continue the policies he has initiated maintain the standards set by him in conducting the affairs of the Institution.

THE INSTITUTION

The Institution, Sir, is the oldest and the largest professional engineering body in the country having a membership of over 80000. During the last 54 years of its existence, it has been providing continued professional guidance to its members, thereby helping them in keeping their knowledge uptodate. Engineering and technology have developed to such an extent in the last 25 years, that it has indeed become difficult to keep pace with them and several specialized societies have emerged even in our country to cater for the special needs; in spite of this, the loyalty of the engineers and technologists, as a whole, has remained with the parent organization, namely, the Institution of Engineers (India). It is therefore essential that this Institution continues to do its best to keep pace with and cater for the needs of the entire engineering profession so that different divisions will not have the necessity of having separate societies for their own specialized fields to keep their professional standards high and uptodate.

It is a matter of great pleasure for us that a large organization like the Mechanical Engineering Association, presently functioning at Bombay, has decided to merge with the Institution. I take this opportunity to extend an invitation to our brother members of the other specialized engineering societies, namely, the Institution of Telecommunication Engineers, the Institute of Chemical Engineers and the Institute of Metals to join us and strengthen the Institution in the respective fields of activity. We, on our part, do appreciate the need for developing the inter-disciplinary areas of engineering, interacting with applied sciences, eg, chemistry, physics, geology and metallurgy, and ready to extend all help to make it easy for these institutions to join us. Similar is our request and offer to our architectural engineers. I do hope that these societies will kindly consider this offer of friendship and become one with us to make the Institution even stronger and more useful to the entire nation than what it is today.

STUDENT

We all know that nearly 60 percent of our membership is made up of our Students who have joined us to improve their qualifications through the examinations conducted by the Institution. It is essential that the Institution goes on improving the standards of these examinations to keep pace with those set by the leading universities in the country. I do not know whether presently the Students have facilities to get coaching in the modern aspects of engineering. If such facilities are not there, it will be appropriate that the Institution helps the Students to gain access to the facilities available at universities and technical institutes to ensure that the standard of Institution examinations on the one hand and the raining of the Students on the other, could match with each other.

CHALLENGES AND OPPORTUNITIES

I feel that this is an appropriate occasion for me to say a few words about what may be the challenges and opportunities today for a technical institution like ours.

Our society is presently passing through a historic transition marked by an unprecedented rapidity of change. For the first time in human history, we are uncertain as to whether the conditions under which we live can be transmitted, substantially unchanged, to the next generation. Even within a generation we have consumed more earth resources and demolished more forests than in all preceding history. But even as man, sided by technology, disarmed nature thereby greatly increasing his tribe, and won an unfair battle against animals and trees, it has been becoming clear that the fruits of his adventure are of doubtful value. Within less than a generation, lush forests have been reduced to huge agricultural dust bowls, attended by an uncontrolled degradation of the soil and unpredictable changes in the physical and chemical regimes of ground water and the atmosphere, the cumulative effects of which have yet to be gauged.

Meanwhile the wheels of industrial technology have kept on grinding inexorably, depleting non-replenishable earth resources and tampering unwittingly with the subtle earth processes which might yet turn out to be nature's fiercest weapon in priming our members to the carrying capacity of our delicately provisioned planet.

The crisis of base metal depletion and of energy resources is already upon us and man is a hapless spectator of his staggering multitudiness which is fast outstripping his provisions and generating psychological stresses about which we still know very little; all the while our numbers grow, our aspirations rise, and our options recede.

But equally indomitable is the human spirit and prodigious is the power of human intelligence and its urge to utilize knowledge for creative purposes. These attributes are central to the human mind and are exercised even by the earliest man. The problem of keeping knowledze alive and of utilizing it in guiding all human endeavour has, however, been one of the continual struggles of man. In India today, the common man's urge to bridge the gulf between his comforts and that of his contemporary in a developed society in one leap is creating technological and sociological problems of great magnitude.

FIVE-YEAR PLANS

Let us therefore look upon our tasks of the future in this light and bring the best in us to our aid for satisfying this urge of the common man.

The country is only a month away from embarking upon the Fifth Five-Year Plan of national development and, as we are all aware, the present estimate of expenditure on development exceeds Rs. 53000 crores. It looks a stupendous task for us to achieve the goals laid down in the Fifth Plan when we consider that the Fourth Plan expenditure was only around Rs. 20000 crores. However, the present goals are in keeping with the challenges that we have to face in the future in the context that the present rate of growth of our population could take our number to 100 crores by the end of the century. At the same time, it is known that the entire resources of our country, as estimated now, will not be able to sustain a population of as much as 100 crores even when fully developed. Thus, control of population and development of our resources at the fastest possible rate are both an urgent and unavoidable necessity. We are short of food, shelter and clothing even for our present population and an increased population at the turn of the century, which would expect a higher standard of living will certainly need tremendous efforts on our part. We should also simultaneously endeavour to maintain our natural wealth and environment.

The Institution on its part commends the Planning commission for the bold Plan it has envisaged for the nation's welfare and offers the Government its fullest possible assistance and cooperation in shouldering the burden the Plan lays on it. The Institution fully recognizes the dangers and formidable problems that the frustration of the common man would pose in case the Plan fails to meet expectations.

Our standard of living has gone up considerably in the last 26 years; yet, as I said earlier, the common man is impatient and desires to go much faster. We cannot, therefore, afford to slow down the pace of our development. It is a different matter if the international situation of other natural or man-made calamities prevent us from achieving what we aim at; but if we fail to hope for the best and plan our efforts accordingly, it will amount to our accepting defeat even before the battle begins. We must not surrender to pessimism but strive our best to achieve the goals set by the Government for the Fifth Five-Year Plan. I wish to assure you, Sir, and through you the Government that our Institution stands fully by its side in its great tasks and will devotedly undertake any responsibility that the Government may like to entrust.

We might pause to think as to what is required to be done in order to ensure steady, stable and speedy progress of our country. The first thing that comes to my mind is that we should educate our people of the dangers ahead in case we did not progress fast enough. In this task, educated people will have to naturally play a major role. Our Institution represents a very important sector of the educated community and would most willingly and readily use its organs for is seminating the relevant information and knowledge.

One of the important changes to be urgently effected in the present environment is the restoration of discipline in the educated sector. Nearly 70 percent of our population is illiterate and is employed mostly in agriculture. It is only in this sector that production has continuously increased, excepting when natural disasters overtook the efforts or when the educated community failed the cultivator in getting him water, power, fertilizer or seed in right quantities. In fact, the agriculturist has not failed us at any time. Thus, if the educated community were to keep itself on the disciplined and patriotic course, our steady development will be assured. If the vast section of the agricultural population, which just gets the necessities of life, can go on working without disrupting the production of food for us, it is for us, the educated community, to think whether it is justifiable for us who enjoy a far better standard of life, to take to a course which may disrupt production in the other spheres of national economy.

At the same time, it is essential for the employers take notice of the problems faced by the various section of the educated community. It is obvious that in a socialistie society, equally educated and responsible sections of the community should have equal opportunities and prospects in their professional careers. Any differentiation between various services will naturally lead to disatisfaction. I hope I am representing the views of the community as a whole when I say that the educated community does not necessarily want more wages but what it wants is equality in wages. I would venture to suggest that instead of having separate pay structures for services in the Centre and the States, there should be a 'functional pay structure' with as few grades as possible with dearness adjustments in relation to places where the employees live. This is the pattern that the United Nations is adopting for their services and I understand Pakistan also is adopting a similar pattern. This is a point which the employers should accede to bring about stability in the thinking of the educated community; so that it could lead the country towards steady progress particularly because it is only the educated community that can understand fully the implications of any dislocation in development activity today and exercise the need controls to prevent them.

One of the major causes of dissatisfaction among men in professional services has been the denial of opportunity for the professionals to work directly with the presentatives of the public in the Government. The possibility of creating an 'Indian Secretariat Service' to which recruitments may be made at appropriate levels from all walks of life on a competitive basis through a suitably designed examination conducted by the Union Public Service Commission is worth consideration, as I feel that such a step may solve this problem for all time. At this critical stage of the country's development, it is essential that all sections pull together in the same direction and I hope the Government will duly examine the suggestion and initiate necessary action.

Another step to ensure steady rise in production and success in achieving the goals set before the country by the Fifth Five-Year Plan is the creation of a machinery to educate our semi-educated community such as the factory worker, the railway employee, etc, in regard to the consequences of their not doing their best in whatever field they work. In this context, it would be worth providing the workers with incentives proportionate to their production outputs in the form of bonus or extra wage or facilities. 'Hard work should get more less work should get less' may be the guiding policy ensure maximum development. It is only then that the common man's urge to acquire more comfort can be met within a foreseeable future.

NATIONALIZATION OF MAJOR RESOURCES

As I said earlier, we have a gigantic task of supporting our population which will grow further in the next quarter of a century. Considering this, it is essential that disputes relating to resources such as river waters, etc, should not be allowed to hamper progress. For example, Narmada waters, which amount to nearly 30 million acre-feet, are just let into the sea unharnessed, while arguments on sharing of the waters and power likely to be available have been continuing for years between different States. As a result, it is not only the people of ions where the river flows but the entire nation suffering. It is time that serious consideration is to nationalize all our rivers and inter-State resources as mines, oil, ground water, etc, so that local rivalries do not disrupt exploitation of these resources are already very scanty. I hope the Government will take a bold step to nationalize such resources and ensure that the entire development of resources and the industrialization flowing from it are based on sound economic and technological grounds.

The energy crisis is already upon us. Our Past President, Shri J G Bodhe, deserves our congratulations on his organized a national Seminar on 'Power-Preoblems and Planning for the Future.' I hope definite and fruitful conclusions will result from it. It is obvious that the oil resources of the Middle East will be exhausted by the end of this century. Our own oil and coal resources are not likely to take us very far and therefore exploitation of other resources such as atomic power, solar energy and hydrogen 'fusion' which can yield almost inexhaustable energy, is essential and Research in this direction should be intensified.

ADVANCE INVESTIGATIONS

I have been associated in some measure with some of the major projects in the country in their planning and design stages. I have noticed that quite often we are to base our design on insufficient data since data collection can start only when funds are sanctioned for a project. But collection of data on hydrological and seismological aspects takes a long time to collect and is, therefore, need to create agencies which can continuously collect data on a long-term basis. Obviously, designs of future projects based on such data would be more realisitic. As at present, it is not at all appropriate to the investigations for a project with its sanction. Investigations on the other hand should start very much ahead of the sanction. Some of the States, it is happy to note, have just begun to take up such work but it will have to be necessarily pursued on a much larger scale. We must plan for the posterity right from now.

TRAINING OF ENGINEERS

During the last 10 years, many facilities have been created in the country to enable engineers working in the field to attend short-term courses run by universities and professional institutions for refreshing and updating their knowledge. The nature of responsibilities accruing from intensive industrialization and the great need to associate technical personnel with policy making require that the training of engineers is diversified so as to include, besides technical skills, other skills such as management, administration, planning and legislation to ensure that trained engineers are available to take up responsibilities in the national sphere in larger numbers than at present. To achieve satisfactory results in this regard, the employers should extend the required facilities to their engineers on the one hand and the universities and professional institutions should intensify the organization of training, refresher and continuing education courses. I may mention that in some of the advanced countries of the world it is the professional men who have been assigned the responsibilities for planning and legislation besides administration and management; and this has enabled the consideration of national projects in their totality not only with respect to their technological impact but the sociological aspects as well. There is urgent need for similar action in our country and I hope this suggestion will receive due consideration by the Government.

CONCLUSIONS

I have indicated in a broad way how central and vital is engineering to the fulfilment of community tasks and achievement of national goals. Many nations the worldover are in transition. They are taking on a 'new look'. It is urgent that the confidence and interest of the coming generation in technology and science is restored vigorously. Despite the prevailing skepticism, without the devoted and dedicated efforts of engineers and scientists and without the profound contributions of engineering, there will be no way to tackle, much less solve, the economic, social and environmental problems that are before us. In this background, I have no doubt that the benign Government will further recognize that the profession of engineering has potentially the most significant and realistic input to the planning of a 'total' national programme and encourage and establish a structure which will provide for greater involvement 'and opportunities to engineers and engineering societies. On my part, I thank the Council of the Institution once again for choosing me to shoulder this high responsibility and invite them to initiate thought and action on the suggestions I have placed before them and the Government for whatever they are worth. I need not reemphasize that we are today at a critical juncture in the life of our nation and it is our duty to assure the nation of our unstinted patriotism and desire to serve it to the best of our ability. I hope and pray that we stand the test and challenge of these boldly and successfully.

JAI HIND

Dr Jai Krishna—a Brief Profile

Dr Jai Krishna, Padma Bhushan, BSc, CE (Hons), Ph D, FNA. FASCE, MISET, FIE, Vice-Chancellor, Roorkee University, an eminent educationist, an internationally known authority in civil and earthquake engineering and receipient of Sir Shanti Swarup Bhatnagar Award for outstanding achievements in engineering, has been elected President of the Institution of Engineers (India) for the session 1974-75. He will take office at the 54th Annual Convention of the Institution which will be inaugurated by Shri G S Pathak, Vice-President of India, on February 16, 1974, at Poona.

Dr Jai Krishna, obtained his bachelor's degree in science from the Agra University in 1932 securing the University Merit Scholarship. Thereafter he studied engineering at the Thomason College, Roorkee, from where he passed with Honours in 1935. He was receipient of several awards such as the Thomason Prize for Merit, the Cautley Gold Medal, the Calcott Reilly Memorial Gold Medal, etc. He took the doctor's degree in civil engineering from the University of London in 1952.

After working for four years in the Public Works Department, Uttar Pradesh, Dr Jai Krishna joined the Thomason College. Here he rose to the rank of Professor and Director, School of Research and Training in Earthquake Engineering in 1960 and of Vice-Chancellor of the Roorkee University in September 1971. He had the unique distinction of introducing into the engineering syllabuses the first courses in soil mechanics (in 1948) and in structural dynamics (in 1958) and of initiating research in , earthquake engineering in our country in 1960.

Design and constructions of civil engineering structures has remained the main concern of enquiry with Dr Jai Krishna. Since 1956 he has mainly devoted himself to this field of research and this has resulted in the establishment of the School of Research and Training in Earthquake Engineering at Roorkee. In the context cf intense technical work of a high standard, the school has acquired international recognition. Dr Jai Krishna has been a Visiting Lecturer at the International Institute of Earthquake Engineering, Tokyo, Japan.

Dr Jai Krishna has made valuable contributions in the field of earthquake engineering. His work has brought in new and original ideas in the design and construction of earthquake resistant structures which have led to the evolution of economic design and construction practices. Some of his noteworthy research contributions in this field are: (a) evolution of methods of strengthening brick buildings to resist earthquake forces, (b) design, construction and installation of structural response recorders and accelerographs in India to collect seismic data for design of structures, (c) earthquake resistant design of water towers and other structures of pest-earthquake Importance, (d) earthquake resistant design of dams, bridges and other major structures, and (e) introduction of the concept of iso-acceleration lines indicative of earthquake forces in epicentral tracts for the study cf distribution and attenuation of energy from the earthquake source. He has also been responsible for the earthquake resistant designs and construction of many Important structures at our river valley and other project sites. Dr Jai Krishna has published more than sixty papers and a text book on Reinforced Concrete in two volumes. The widespread application of the results of his research Investigations In India as well as abroad have more than proven the great utility cf his eminent technical contributions in a variety of fields.

Dr Jai Krishna has had a leading part in the field of standardization as well. The various standard codes of practice for the design and construction of earthquake and blast resistant structures developed by the Earthquake Engineering Sectional Committee of the Indian Standards Institution under his chairmanship have helped the country in providing adequate safeguards against earthquake forces in projects and other constructions. His outstanding researches and practical achievements have not only contributed towards better understanding but greater confidence in tackling the problems of design and construction of earthquake resistant structures in the country and elsewhere as well. Further, the instruments and facilities for laboratory and field testing developed under his guidance have led to complete elimination of foreign consultancy on such problems on the one had and have greatly helped import substitution and export promotion on the other.

Dr Jai Krishna has played very active role in the establishment of the Indian Society of Earthquake Technology and the International Association of Earthquake Engineering. He has also guided the organization of several symposia on earthquake engineering at Roorkee since 1959 and similar

International conferences In various countries of the world since 1956, all of which have immensely added not only to enrich the available knowledge in the field of earthquake engineering but to help dissemination of such knowledge for the growth and furtherance of studies as are relevant.

Dr Jai Krishna was awarded he Railway Board First Prize for 1957-58 for his paper on 'Earthquake Engineering Problems in India' by the Institution of Engineers (India), and later the Khosla Research Award in 1963 by the University of Roorkee. He is an elected Fellow of the Indian National Science Academy, a Fellow of the American Society of Civil Engineers and a Fellow of the Institution of Engineers (India) and continues as Director of International Association for Earthquake Engineering since 1966. He was the Founder President of the Indian Society of Earthquake Technology. He is a member of the UNESCO Consultative Committee on Earthquake Engineering, and Vice-President of the International Association of Earthquake Engineering.

Dr Jai Krishna was honoured with the Sir Shanti Swarup Bhatnagar Memorial Award for 1968 by the Council of Scientific and Industrial Research, the National Design Award by the Institution of Engineers (India), in 1971 and the K L Moudgill Prize for 1972 by of the Indian Standards Institution.

Dr Jai Krishna was conferred Padma Bhushan by the President of India on the Republic Day in 1972 for his meritorious services to the nation .

Dr hi Krishna joined the Institution as Associate Member in 1945; was transferred to Member in 1950, and became Fellow in 1971. He has been a member of the Council for a number of years and was Chairman of the Civil Engineering Division during 1971-72 and 1972-73.

Dr V M Dokras

President 1975-76

Presidential Address

INVENTIVE SKILLS vis-a-vis INTERMEDIATE TECHNOLOGY VITAL TO OUR FUTURE

'Most respected Rashtrapatiji, Rajyapalji, Honourable Chief Minister, my distinguished Predecessor Dr Jai Krishna, Past-Presidents of the Institution, delegates from foreign countries, Chairman of the Reception Committee, Members, Ladies and Gentlemen:

I consider it a very great honour to The Institution of Engineers (India) and to me personally that the President of India, Shri Fakhruddin Ali Ahmed, has so gracefully consented to inaugurate this 55th Annual Convention of the Institution in the romantically picturesque surroundings of this age-old city of Lucknow.

We are grateful to you, Sir, the first and highest Citizen of the Country, for honouring us with your August presence and thereby recognizing the role of our Institution and the importance it has in contributing to the welfare of the nation.

I am equally happy that His Excellency Shri M Chenna Reddy, Governor of Uttar Pradesh, and Shri H N Bahuguna, Chief Minister of the State, have been kind enough to be with us today. We are sincerely thankful to you, Sirs, for the opportunity you have thereby afforded to us to be with you.

LOOKING BACK

I am beholden to the Council for having elected me President of the Institution of Engineers

(India) for the Session 1975-76. I shall be failing in my duty if I do not express on this auspicious occasion my gratitude to my colleagues in the Institution Council on this account. I realize that the responsibilities of this office are great; even so I am confident that you will guide me to do my best by kindly extending your invaluable cooperation and collaboration, both individually and collectively, in achieving the tasks that lie ahead of me. The Institution has all along been headed by engineers of the highest calibre in the country and I have deep respects for all the yeoman services they have rendered and the fruitful results they have achieved in bringing the Institution to its present high status. I also thank my predecessor, Dr Jai Krishna, for the many significant decisions he has made available to us to solve some of the issues which have been pending for a long time; notably, among others, for the decisive guidance and acceptance he secured from the membership as a whole towards enhancing the membership strength of the Institution as well as the membership subscriptions which are both vital to support the numerous activities that are of interest to the welfare of the profession.

As you know, no institution can work without adequate financial support and ours is one of the institutions in the whole world whose membership fee is not only very low but has been retained as such so long, despite heavy odds on many counts. And yet the Institution has continued to shoulder the burden of organizing more and newer, technical and professional activities with the best of devotion, only to expand the horizons of the profession further and further. After all, endeavours of this nature have their ups and downs, in spite of very best efforts for reasons beyond their own limits. Notwithstanding such a situation and the sagging pressure of the two formidable tasks just mentioned above, my predecessor and his council have achieved remarkable successes, needless to say, by the generous help of you all. He has thus handed over to me now an Institution which is not only in good academic shape but in good financial shape as well. I assure you that I shall try to follow the policies he and his predecessors have so ably and selflessly initiated to maintain the standards of the engineering profession and through this the high status of your great Institution.

THE INSTITUTION AND ITS PURPOSE

Our Institution is the oldest and the largest professional institution in the country having a membership, of over 80000. As far back as 1915, it was realized that engineers need to build a society of their own, not only for aiding and supporting them in their academic advancement, but for providing a common forum for mutual exchange of thoughts. Even at that time, the impossibility of maintaining a separate organization, for each branch of engineering became obvious, in as much as the members of the profession were dispersed over so enormous an area as our country and earlier attempts to do so pad proved, to a great extent, unfruitful. It is essential that proper and adequate physical facilities must be ensured and made available if the various engineering disciplines have to participate responsibly in the tasks of advancement of engineering and exchange of thoughts. In addition to this, all the disciplines should, without exception, accept and act with an interdisciplinary approach to realize fruitful results in handling the various types of problems which beset them. Fitting itself as a service centre for the profession almost since its inception in 1920, the Institution has, through its 18 Local Centres and 39 Sub-Centres, provided a network of facilities needed for dissemination of knowledge and professional advice throughout the country, Besides this, the Institution is also quite well equipped to provide more such Centres whenever and wherever they are needed, especially in our new temples of industry that are springing up throughout the length and breadth of the country.

The purpose of an, association of engineers as ours is not merely to organize annual sessions; it is much more. Its principal responsibility is to serve the entire membership by providing continuous professional guidance, by permitting discussions on the various problems concerned with engineering at all times, by holding symposia, seminars, lectures, etc on subjects of current engineering interests and by organizing common links and forums in the country to cater for purposeful exchange of technical and professional thoughts among the members themselves as well as with others. It is only by the fulfilment of these objectives that the Institution can continue to be ever 'active and alive', I am very happy, indeed, that our Institution has greatly succeeded in this task.

Fully realizing the imminent need for a united front of engineers, my predecessors, had appealed to other sister institutions in the country to collaborate with us in technical activities and thereby help us strengthen the engineering profession as a whole as well as individually according to their specialities. I reiterate this appeal and hope that this unity will be achieved to the benefit of us all in the near future.

I wholeheartedly re-assure them that it is not with a big brother attitude that we have made our appeals to them — their purpose is pure and simple — they are mainly concerned with the total interests of the entire engineering fraternity in the country.

PROFESSIONAL EDUCATION AND STUDENTS

To advance in one's life is the goal of everybody. To those persons who are not able to get to the engineering degree level due to various reasons, the Institution is providing ample avenues. The passing of Sections A and B Examinations of the Institution is recognized as equivalent to a degree in almost all walks of life in our country. The Students of the Institution who form more than 60 percent of the membership have, therefore, every reason to be proud that their Institution has provided them an invaluable opportunity for their uplift in an environment where almost every development has depended on the fruits of engineering and the efforts that engineers are putting forth.

Only last year, the Institution updated its syllabuses and adopted a new system of examinations which is equal to systems employed by the professional institutions in other parts of the world and the main aim of both these exercises has been to 'better' the students and equip them to be at par with students who are marching ahead in a technically fast advancing atmosphere. I would like to point out that while the Institution is making all-out efforts to help the Students in all possible ways, it is very necessary that the Students themselves must realize that engineering science is continuously adding to its frontiers and self-development will very much depend upon how well and in what time they would acquire the virtues and capabilities to reach even the innermost boundaries of knowledge. I would appeal to the Students of the Institution that the profession of engineering is a hard one and unless they are prepared to exert themselves, there will be no future for them. We, engineers, are the backbone of the country and it is this backbone that has to be strengthened so that development schemes envisaged for community well being under our National Five-Year Plans are carried out as quickly and economically as possible. It is again in this direction that I would like to repeat my appeal to all those concerned and especially the students.

OUR MANY SHORTAGES

Looking through my experience in the profession over the last 25 years, I find that our country is getting continuously plagued with several kinds of shortages — shortage of power, shortage of materials, shortage of appropriate technical manpower, shortage of technical skills, shortage of capacity to look forward, and so on. Planning can only be based on realities, it cannot be based merely on formulae. We cannot by any means eliminate or even avoid any of the shortages, particularly the shortage of materials.

If we examine the world in the above circumstances, we see that there are two types of countries — those which have abundant resources, and those which have no resources at all excepting technical skills, foresight and capacity for hard work. In this sense, we in India are fortunate that we have at least some resources. Let us not fritter away these natural resources because once wasted they cannot be recouped. Exploration and exploitation of our resources is an inevitable need if we are to grow and, to be true, our country offers great prospects in this regard. However, we should not go back in our efforts to find out substitutes for all those materials that we now lack.

THE CHANGING EMPHASIS

Our country is neither a developed one nor can it be classed as an underdeveloped one; we are a half-way house. We have now been trying to change our orientation from a traditionally agricultural economy to an industrial economy. It is, however, obvious that without an industrial base no agricultural economy can subsist or sustain itself. This change of emphasis has been creating a variety of problems, both of materials and technical skills. As far as technical education for developing the necessary skills is concerned, the educational system we are following presently has been evolved from the one that was created in the pre-independence era where the major aim was, no doubt, to provide technical skills for the country; but it did not help creation of imaginative skills without which no true progress can be achieved indigenously. Immediately after independence, it was realized that unless the curricula of our engineering institutions were radically changed, the technical expertise required for planning and implementing our own industries would not become available.

Based on this thinking and the hard facts gained by experts from experience, many steps were taken to remedy the situation. Needless to mention that our country has suffered much because we have built up and practised a technical education system catering only at extreme limits—a system having an upper strata and a lower strata, but without a middle strata, to produce required technological skills. Whether a remedy to offset this situation would succeed by a mere re-orzanizational step is a matter for considerable speculation.

One of the unfortunate aspects of the new developments we are surrounded with has been that the educational authorities of the developing countries like ours have always looked forward to the western world for the formulation of the contents of the technical education they would offer to their students, without giving enough consideration to the fact that the students will have to have a great amount of exposure to mechanical skills, if they have to play their real part in national development. Therefore, what has been emphasized in our systems of education so far is more of theoretical knowledge; there is total lack of interest in a system orientation where working on all sorts of problems with one's own hands can alone fetch results.

NEED FOR APPROPRIATE TECHNOLOGIES

Turning to our industrialization plans, it is disappointing to note that we are always going in for turn-key projects backed up by the most up-to-date and advanced technologies. This is a matter which needs to be looked into with serious consideration. This being so, I strongly feel that there is an urgent need for us to develop an 'intermediate technology' for our own purposes. Although we are now able to explode a nuclear device and run a completely imported factory, it does not mean that we are equipped in all ways; truth to say, such superficial capacities will not go a long way to help us in acquiring an indigenous base for our industrial development. Our technology and our future will have to be based definitely on our local talents and capacities to the maximum extent. We must at all costs stop indiscriminate requisition and use of imported technology.

In this background you will appreciate that we must at once commence rethinking on the system of engineering education that would best serve us. At present, as pointed out earlier, our education is based not on relevance. I firmly believe that the future engineer should be able to fit himself into his profession. Therefore, we should not only change our present attitude to education but urgently adopt measures to train our engineers which would fit them for levels of work concerned with higher technologies as well as with intermediate technologies.

The fear in the minds of many of our people in recent year that we are overproducing engineers is, in my opinion, not based on real appraisal of the situation. What we are producing is not the correct types of engineers that we really require. We have got to develop engineers who have entrepreneurial skills, which will equip them to start something on their own without having to look out anxiously for jobs externally. We have also failed in another way, that is, our present engineering education is totally lacking in several other quarters also. For example, let us consider the financial economies and fiscal procedures an engineer has to care for besides the many aspects of human engineering, in his day to day work. Our present courses do not take into consideration that the practising engineer would have to bother himself about accounts, inventory controls, governmental procedures, etc when he gets into the field, and unfortunately, as facts stand, none of the above aspects finds a place even in their barest outlines in our course programmes.

HOW TO GO ABOUT

At the commencement of my speech, I referred you to the shortages that are plaguing us. If we cannot make-up for these shortages and adopt strict measures for the conservation of essential resources, our future will be bleak. One of the basic shortages, as I feel, is the shortage of housing. Millions of our people have practically no roof on their head; and if our aim of providing a minimum shelter per family has to be realized we cannot just depend on our current supplies of steel and cement for the purpose. There is great urgency for us to develop new and cheaper types of readily available building materials. Research and developmental activities in the concerned fields of engineering should at once be directed to come out with results notwithstanding how small the results are in the initial stages. In this particular context, it is also most necessary that we should develop and tryout new concepts in our building techniques.

RESOURCES CONSERVATION CRUCIAL

I have been personally connected with schemes for the utilization of waste materials for over 10 years now. We are producing from our super-thermal stations thousands of tonnes of fly-ash every day. The disposal of this material poses a difficult problem to engineers. I would suggest active research and development work to determine the feasibility of utilizing this fly-ash for making bricks and improving foundations so that scarce materials are saved.

I have always felt that the 'lowest tender business' of our activities has done more harm than good to the country. What we have to bother about is the quality, capacity and timeliness of the output and not the lowest price we can pay for getting the output. We have found that most of the time the lowest tender becomes the highest, thereby making us lose precious money and time heavily, which we can ill-afford when we consider the sufferings of our common people.

There should be a strict bar on the use of materials which could be substituted. The schedule of materials required for any project should be studied before and in all its details and the materials that are scarce should not be allowed for use at any cost.

R AND D HOLDS THE KEY

Again, in our industrial development programmes, there does not seem to be any common channel whereby a research worker in a teaching institution or in a research laboratory could exchange himself into industry where he could tryout his research results and the engineer in an industry could go to an institution or a research laboratory to update his knowledge. This lack of provision has been resulting in wastages at both the sources because the researches carried out are only of basic types and are not at all related to the requirements of industrial developments. This has also resulted in widening the gap between the two categories of workers. I am not against basic research when I say so; the real fact is that today the country is facing many problems in the field of technology. This being the case, we have a lot to gain if only our expertise as well as manpower could be efficiently geared up to tackle solutions for such problems in an adequate measure. I very strongly appeal once again that the research facilities and the funds we have should be more beneficially utilized.

INNOVATION SPIRIT—A MUST

To my mind it appears that our present and more urgent need is technological innovation for which specialist personnel will have to be trained. In attempting to determine how we should foster research oriented towards technological innovations, we must be very clear about what we have to do. The mere understanding of a specific phenomenon, does not contribute per se to technological innovation. We have got to go ahead not only to understand the phenomenon but proceed on the results of such understanding to remedy the situations we are faced with and find out something new. This thought should receive proper weightage in the formulation of scientific and technological policies for our country as a whole.

SUMMING UP

The research and development schemes envisaged for the Fifth Plan have to be based on the relevance and appropriateness of the output of knowledge, skills, techniques, processes and equipment required for the implementation of projects which will have to meet the needs of the country. Similarly, as indicated before, in the field of education, the main role of our technical institutions would be to develop knowledge and skills which are most appropriate to our demands.

Yet another important aspect of the concept of relevance is related to the explosion of knowledge in many specialized areas. Several fields, of which we did not have even remote knowledge thus far, have now come about, fully established and recognized, as separate disciplines in their own right. To cite a few such, we have cryogenics, microelectronics, tetrotechnology, laser technology, tribology, plasma physics, environmental technology, etc. This. has given rise to the emergence of further interdisciplinary fields of study such as medical electronics, biomedical engineering, avionics and so on, all of which require deeper knowledge than the traditional. Cutting across these old and new fields, there have also evolved some integrating disciplines such as systems engineering, operational research, management sciences, value engineering, etc which we engineers require not only in pursuing our engineering goals but in our routine business and administration.

Developments as complex as those outlined above cannot be easily explained in terms of an integrated analysis or a general philosophy of the total process. The inter-relationships between science and technology, economic and social change, and industrial progress are clearly changing in significant ways, the understanding of which is advanced but by no means complete. It is, however, possible to try more meaningfully, to being forward at least tentative results.

There is a wide range of measures which would contribute to the building up of our national and scientific and technological capabilities, as well to the success we are endeavouring in terms of innovation and indigenization. These measures would imply a new stage in science and technological policy in the coming years, including close integration with economic, industrial and commercial policies.

The principal objectives which need focussed attention would be: (a) to relate the national science and technology policies more explicitly to clearly-defined economic, social, defence and other objectives, in order to provide clearer orientation of effort, leading to better utilization of and more economic output from scientific and technological resources; (b) to define the possible contributions science and technology could make to a wider range of national objectives; (c) to strengthen communication and cooperation among industry, the universities, professional bodies and government agencies, in order to ensure that science and technology do not get isolated from those who could with benefit apply the results of their scientific and technical work to national development; and (d) to consult industry and the profession much more comprehensively in the formulation and execution of policies, in order to overcome the weaknesses in the innovation processes.

In the light of the above, naturally enough we have to try our utmost to update our educational system to be responsive to the burgeoning developments all around us. Further we must develop a self-reliant economy and fill in our technological gaps by indigenous efforts. For these purposes, we will have to increasingly use different disciplines of science and different kinds of technology but 'appropriately' to suit our own environs. Of course, the starting point for the establishment of these is education. But when one acquires the theoretical knowledge related to these disciplines and technologies, he rightfully looks into opportunities in the field where he can practice what he has learnt. And it is here that your Institution takes him on.

I now request our Rashtrapatiji to inaugurate the Convention.

Dr V M Dokras—a Brief Profile

Dr Vasant Madhav Dokras, BSc, MSc, CIISc, MS, PhD, FIE — an eminent educationist, a reputed teacher and researcher and a leading chemical engineer in the country — has been elected President of the Institution of Engineers (India) for the Session 1975-76. He will take over this office from the retiring President, Dr Jai Krishna, Padma Bhushan, BSc, CE (Hons). PhD, FNA, FASCE, MISET, FIE, Vice-Chancellor, Roorkee University, at the 55th Annual Convention of the Institution at Lucknow which will be inaugurated by the President of lndia on February 16, 1975.

Election of Dr Dokras as President has come at a momentous time — bringing, as it dues, to limelight the great importance the Institution attaches to the advancement of developing disciplines like chemical engineering, metallurgical engineering, etc; providing a stimulating excursion into new thinking on the structure, status, functions and furtherance of newer technologies; and adding a new depth and meaning to the continuing, intensive-action programmes on which the Institution has set itself to lead and enrich the growing engineering areas to major specialities.

Born in 1919, Dr Dokras was educated at the Nagpur University, wherefrom he obtained his Msc degree in 1940 distinguishing himself as a first in first. Later at the Indian Institute of Science, Bangalore, he studied chemical engineering and followed it up by postgraduate work. Obtaining his CIISc in 1941, he took up research in the field of organic chemistry at the same Institute and carried out intense studies on the development as well as commercial production of basic chemicals for high explosives under research schemes sponsored by the Council of Scientific and Industrial Research. In 1945 he was awarded a scholarship by the erst while Government of Central Provinces and Berar for advanced training in the United States.

Thereafter pursuing his studies at the Columbia University during 1945-48, Dr Dokras obtained his MS degree in Chemical Engineering and Metallurgy in 1947 and also the PhD. degree from the same University soon after specializing in electrode position and electro-winning' of germanium. After gaining further research and practical experience in internationally known organizations and universities devoted to chemical engineering research and development both in the USA and he UK immediately after the study-period, he returned to India in 1948 and was first appointed as Deputy Director of Public Instruction (Technical) by the old Madhya Pradesh Government. He was then made Officer all Special Duty in charge of investigations for the iron and steel project at Bhilai and the thermal power station and aluminium project at Korba, where he did commendable work. Dr Dokras was next appointed as Joint Director of Technical Education, Madhya Pradesh, in 1956. For over 12 years from 1945 to 1957, assiduously engaging himself to the task of development of technical education in his State, he played a leading role in the formulation of a Five Year Plan for technical education, establishment of a number of polytechnics, development of established engineering colleges and organization of a new engineering college at Raipur. As a member of the Board of Technology of the All India Council of Technical Education, Dr Dokrns was also responsible for rendering advice to tho Government of India/on matters related to developments in technology.

Following the reorganization of the States, Dr Dokras took over as Principal, Government College of Engineering & Technology, Raipur, in 1957 and saw to its full-fledged development as a college imparting education in all the important divisions of engineering. He worked in this capacity till 1959 when he became Principal of the Government Engineering College, Jabalpur, In this assignment, he put into action a number of schemes which enabled closer collaboration between industry and the educational institutions he was serving. Further, he also initiated and implemented a number of postgraduate programmes concerned with integrated problems of science and engineering during this period.

In recognition of his zeal, devotion and meritorious contributions to the cause of technical education in Madhya Pradesh, Dr Dokras was deputed by the State to the USSR to study the system of technical education in that country. After his return, in further appreciation of his leadership qualities and distinguished services as, an educator and educational administrator, he was appointed as Director of Technical Education, Madhya Pradesh, in 1963. Being the first to occupy sucn an office in the Stale and being in charge of directing schemes for re-orientation of technical education, Dr Dokras made significant advances. Credited with many notable accomplishments, he also extended his efforts to create and establish furthermore new technical institutions in the State.

Dr Dokras was appointed Principal of the Visvesvaraya Regional Engineering College, Nagpur, in 1966. Here again, a consistent display of excellence combined with remarkable ability to motivate and persuade others to achievements, has placed Dr Dokras as an outstanding educational leader and most-sought educational consultant in the country.

Recognizing the great need for a close-knit relationship between the engineering profession and the industrial community so essential for both to prosper and keeping himself fully alive to the inevitable influence of one upon the other, Dr Dokras has been consistently crusading the cause of closer cooperation between schools of learning and manufacturing industry. He has all along strived selflessly to establish a 'link' — a personal liaison between the individual in the company and the teacher in the academy. His services and achievements in this-sphere have led to him numerous invitations at national and international levels and have taken on programmed visits to the UK, USA, USSR, France and Germany under UNESCO and other assignments concerned with industry education collaboration projects.

Dr Dokras is actively associated with numerous national and regional organizations and the committees. He was at Member of the Board of Studies in Technology and a Member of the Western Regional Committee, All-India Council of Technical Education. He was the Dean of Faculty of Engineering and Technology, Universities of Saugar a Nagpur. He is a Director of the Industrial Development Corporation of Vidarbha. He was President the Technical and Vocational Section of the A India Educational Conference held at Patna. He associations with professional and scientific societies cover the American Chemical Society, the Electrochemical Society, the Royal Institute Chemical Engineers, etc.

Dr Dokras' association with the Institution has been long and noteworthy. He joined the Institution as Associate Member in 1951, was transferred to Member in 1960 and to Fellow in 1971 He was twice Chairman of the Madhya Prades Centre of the Institution and also Chairman of the Nagpur Centre: As Chairman and Member of the Examinations Committee of the Institution for a number of years, he has made far-reaching contributions to the development of its examinations activities. It was under his Chairmanship that the entire system of examinations as well as the syllabuses of the Institution were thoroughly over hauled, updated and modernized incorporating the latest trends and systems in engineering education as are in practice in the developed countries and their professional engineering societies. Dr Dokras has also contributed much to technical professional and educational literature. In his office as Chairman of the Chemical Engineering Division of the Institution, he has imaginatively led and directed many technical committees and divisional activities catering for the progress of chemical engineering in the country.

His life has thus been a long and thorough preparation — one of cheerful persistence and replete with vision, hard work, commitment and self-involvement in doing things and getting them done in a loving and persuasive way. A dynamic organizer and dedicated leader throughout his illustrious career, our new President has given enough proof of the importance he gives to the character and direction of education, to bring its many sided impact on to the individual. It is our hope that the entire engineering fraternity will get the utmost benefit of his solid intellectual content wide ranging influence, and enlightened guidance and actions to gain better and more professionally.

Prof Dr A Bhattacharyya

President 1976-77 & 1977-78

Presidential Address

(1976-77)

I am grateful to the members of the National Council of the Institution of Engineers (India) and to the members of my profession whom the National Council represents for the great honour they have bestowed on me by electing me President of this premier body of engineers and technologists. I am conscious of the heavy responsibility t is coupled with this trust and honour, and I pray I may have the necessary strength and wisdom to justify the confidence they have so reposed in me.

COMMITMENTS AND DILEMMA

On this august occasion, I would like to commence my Address with an emphasis that engineering which is often defined as the art of directing the resources of nature to man's material welfare, is a trans-disciplinary arena. Leo Apostel defines engineering as 'a man-machine system in a physico-biological environment'. Science observes and formulates the laws of nature while technology develops the applicability of science to human needs. Thus an engineer interacts with the empirical level of science, the observations and laws of which when transferred to a pragmatic level for technological adaption lead to a new set of technology-oriented axiomatics. The engineer has also to interact with the normative level of the societal systems for the transformation process to which the profession is dedicated since its inception. It is further necessary that the purposive level which embodies value dynamic in a continuously changing environment must also diffuse into this trans-disciplinary interaction.

Engineering today is an integral cohesion of the normative level of the social system, the pragmatic level of technological adaptation and the empirical level of scientific observations and interpretations of the laws of nature diffusing into the purposive level of value systems. Therefore, it is in the fitness of things that the Institution of Engineers (India) is an integral body transcending the barriers of disciplines in spite of narrow scientific or technological interests. The day is not too far when the traditional Civil, Mechanical, Electrical, Chemical, Metallurgical, Electronics and other engineering disciplines will disappear giving place to a new set of inter-disciplines comprising Environmental Engineering, Transportation Engineering, Management Science, Industrial Engineering, Energy Science, Water Management, Materials Science, etc. This leading forum of engineers, namely, the Institution, well appreciating and foreseeing that such a change would inevitably come, lost no time even some years ago to establish under the guidance of Prof N S Govinda Rao, a distinguished Past-President, a number of interdisciplinary Panels where traditionally processed discipline-oriented engineers could get together and merge their activities in a broader horizon. Speaking of today, there is hardly any need to stress that engineers should be capable of inter-communication at all levels with a forward orientation towards societal commitment. It is possible that the pseudo-stability of our academic programmes with the nineteenth century concepts may become an obstacle. To overcome this, we must at once dispense with our idea that the advancement of knowledge depends upon a rigid specialization within the module of a discipline. We must understand that the advancement of knowledge in engineering is a result of interplay of concepts, methods and insights between various disciplines at various levels. Knowledge in any area demands for its exponential growth a methodology of compression and comprehension and it is not difficult to establish interconnections, analogies, transfer modalities or convergence characteristics. The computer and many other pedagogical tools in addition to the all-pervading new formats of numerical mathematics are already demonstrating that engineering is structurally trans-disciplinary and the activity pattern of an engineer is not only a process of fission but a combination of fission and fusion.

NEED FOR COMMONALITY

The need for a society in any professional domain has always culminated in the establishment of an institution. Even as early as in the 1920's, the engineers in India felt the need for such a society not only to advance their horizon but to have a forum through which they could meet the challenges of the rapid advances in the frontiers of knowledge. It was in such a background that our founder-members established the Institution, displaying their clear vision that engineering and technology is a trans-disciplinary hierarchy, and hence the Institution would have to serve as a common organization for all engineering disciplines. They did not attempt proliferation into groups and sub-groups or the creation of specialized societies obviously because they clearly felt that maintenance of a separate entity for each group was an impossibility with the members of the profession so widely dispersed over the sub-continent. Therefore, they built the Institution on the model of an all-embracing society incorporating all the engineers in the country irrespective of their specialist functions. In contrast to this, many of the developed nations continued to establish newer and newer societies over the years, resulting in their proliferation as we know. However, recent trends have shown that a higher order society, where members of the profession could be brought together notwithstanding their so-called discipline-wise functions is a great necessity. The United Engineering Centre in the USA and the Council of Engineering Institutions in the UK are some examples of such high order societies. Our Institution, despite its unique role as a common forum, has never discounted the objectives and interests of the various disciplines and sub-disciplines. That this realization was always there on the part of the Institution would be evident from the extracts of the Presidential Address of Mr E J B Greenwood in 1939, which I quote below:

> ' ...... In view with mixed feelings the attempted growth in India in recent years of kindred institutions of an engineering nature; the fold of our Institution is wide and our membership

> includes distinguished representatives of all branches of engineering and its allied sciences. It is conceivable and will inevitably occur that our Institution will form special sections to deal with subjects such as railways, irrigation, water supply, electricity, reinforced concrete ..... All such sections, however, will remain integral parts of the Institution and we may visualize a state in the future when our Institution consists of such sections .....'

Subsequent developments demonstrate the re-emergence of the Institution in the form of a federation. This process was begun in 1944 when four major sections were initiated with a Sectional Chairman at the head of each. By 1963, the bye-laws were amended to make the Institution a full-fledged federation, embracing seven divisions of engineering, namely, Civil, Electrical, Mechanical, Chemical, Mining and Metallurgy, Public Health, Electronics and Telecommunication, with groups and sub-groups established within these Divisions to cater for Aeronautical Engineering, Agricultural Engineering, Automatic Control, Heat Power Engineering, Industrial Engineering and Management Science, Marine Engineering and Ship building, Mechanics of Materials, Production Engineering and Machine Tool Technology, Textile Engineering, Radar Engineering, Nuclear Engineering, Petroleum Engineering, Automatic Control, Prestressed Concrete, Railway Engineering, Structural Engineering, Transportation and Highway Engineering. Soon after many other organizations like the Bombay Engineering Congress, the Mysore Engineers' Association, etc, merged with the Institution. Each Division is now entitled to a separate budget, seperate annual and semi-annual paper meetings and seminars and publishes its own Divisional Journal. The Institution is thus a magnificent body today, having in its fold well over 85000 members in various grades and belonging to different disciplines and regions, with operational centres in 18 States and 39 Sub-Centres at industrial complexes. Our Institution has been the only professional engineering body in India which has been granted the Royal Charter with its bye-laws approved by the Privy Council. After independence, several judicial references have established that the Royal Charter is deemed to be an Act in terms of the Negotiable Instruments Act unless it is replaced by an alternative format by the Indian Parliament. The Royal Charter has conferred on the Institution many important functions including the accredition responsibility of engineering institutions, and the right for a corporate member to affix the title of 'Chartered Engineer' which entitles him to practise in the profession bound by a Code of Ethics laid down by the Institution.

In spite of these high achievements by the engineering fraternity, the governments and public and private enterprises are, unfortunately, ignoring the professional aspects of engineers and are continuing to call upon persons who are either unqualified or not bound by any code of ethics. It is in the interest of the nation that Chartered Engineership should be introduced on a legal basis in order that the engineering profession can be a disciplined and dedicated group serving the nation. The medical practitioners have such a legal standing through registration and very recently the Architects Bill has bestowed on a neighbouring profession the same type of privileges. In these contexts, it is imperative that an 'Engineers Bill' should be drafted in consultation with the Institution of Engineers (India) which, in the eyes of the law, is still the sole organization bestowing Chartered Engineership in the country. The character of the Institution is that of a federation having an all India spread with all-round achievements. As such, Institution is the most appropriate organization which can invite other fraternal organizations, if necessary, to examine a proposal whereby an initiative can be taken for drafting an Engineers Bill. In our post independence era, it appears incongruous that the Royal Charter still not been repealed by an Act of Parliament and the Institution is refounded as a National Body to be who responsible for all aspects of academic and professional engineering transcending through the various allied disciplines and having relevance to the national objectives.

INDUSTRY-MIX FOR SOCIETAL COMMITMENT

During the pre-independence period, the imperial rulers practised a twin system through the so-called maintenance of law and order to exploit the people and rule them. This way they continued the unexploitation disturbed. The so-called industrial expansion during this period was mostly a corollary of political subjudication and never aimed at planned economic growth of the nation. Engineers and administrators were functioning under the premises of Macaulay and greater importance was given to problems of law and order and thus a hierachy was devised in which an all-powerful, know-everything civil service administered the entire governing process. Huge metropolises grew at the expense of a rural countryside not as complementary units but for gathering the rural surpluses generated by the toiling and sweating people at large. History reveals a very interesting picture. The British came to India primarily as traders. They were not willing to part with gold and silver in exchange of Indian goods. The solution they adopted for their problems of trade was political subjudication of the country and they used the land revenue collections to purchase Indian goods to export abroad. The brilliant discovery of this single track transaction did not require, selling of any goods in exchange or paying in gold or silver. Thus they perpetuated their foreign rule for exploiting the country through a one-way transaction of goods. The last year of the pre-British Indian rule was 1764-65 when the land revenue collected in East India was £817533; as against this, in the very first year of the East India Company rule, the land revenue was increased to £1470000 in 1766 and by 1772 it was £2441 000. In 1793 when Lord Cornwall is devised the permanent settlement, he fixed the land revenue at £3400000. This process of rapidly rising land revenue helped to ultimately solve the problem of trade of the then British East India Company, and in this context some of the facts and figures available are revealing. According to these, during the first three years of direct British regime in India, an export of goods worth £6311250 was achieved while the import was only £624375, less than 10 percent of the export, derived mainly from our rural hinterland. England reaped the benefits of the Industrial Revolution, the initial base for which was accumulation from the trade surpluses, while India suffered from a reverse consequence, namely, the negative accumulation that started to operate. To quote the late Pandit Jawaharlal Nehru from his 'Discovery India':

'The independence of the United States of America s more or less contemporaneous with the loss of freedom by India. Surveying the past century and a half, an Indian looks somewhat wistfully and longingly at the vast progress made by the United States during this period, and compares it with what has been done and what has not been in his own country. And yet perhaps it is not inconceivable that if Britain had not undertaken this great burden in India, India might not only have been freer and more prosperous, but also far more advanced in science and art and all that makes life worth living.'

Let us examine the effects of this colonial exploitation which the Britishers carried through an unequal exchange goods culminating in the withdrawal of the surpluses of the hinterland in the interests of the type of development strategy they pursued for developing their industrial base and establishing a kind of metropolitan economy in India. The first effect was that such a strategy did not benefit the common people who generated these surpluses and led to develop a lopsided socio-economic structure in the country. The second effect was that industrial development was concentrated around metropolitan regions only, whereby it avoided the involvement the people. Thirdly, the urgent need for a basic restructuring and reorientation of the industro-commercial of the country began to force itself in order that the industrial sector could function complementarily with agriculture to raise its productivity and provide the purchasing power which could be exchanged against inustrial inputs. The fourth result was that the colonial economy gradually decreased the employment opportunities and became concentrated as a means for production in a few hands. Next, the allied institutions that thrived were usury indulged in rack-renting and speculative commerce. The industries that prospered during colonial rule were jute, plantation and mining, and the engineering industry was meant only for handling repairs, and production of spares, some heavy structurals and some equipment required to keep the ports and the transportation system operational. Further, none of these industries was in any way concerned with supplying inputs to agriculture for, increasing its productivity. The total result was that while colonial industrialization urbanization were making fast strides, they forced peasants to continue to remain poor by taking away irproducts without getting them a proper exchange. Thus by developing a complex mechanism for generating forced surpluses, the colonialists thrived at the expense of low productivity in agriculture. And in such an environment, our profession of engineering also had to serve that mechanism for a long period of time.

In the post-independence period, some of the colonial mechanisms of zamindari and rack-renting have been abolished. It is time that the remnants of colonial exploition and plunder are tackled by reorienting our industrial economy in which the engineers have a big role to play. A new technological possibility is being ushered into the area of agriculture, the dominant part of our informal sector. It is very important that a meaningful involvement of our profession is planned so that a new and more equitable social order can be ensured by means of a remodelled techno-economic restructuring. This requires efficient water management, development of fertilizers and composts, creation of agro-industries relevant to a given region, and so on.

Our current and further planning of industrial ventures should be resource-based and dispersed in the countryside in such a manner that the current inter-regional disparities can be reduced as far as possible. After attacking the imbalance between the regions, attempts will have to be made to bring down the inter-personal disparities by providing more employment opportunities and the implementation of a national wage policy. Thus a meaningful programming for 'Garibi Hatao' should be achieved. Our engineers and technologists should at once discontinue their imported outlook and endless foreign collaborations and should dedicate themselves to serve the people-not the upper 5 percent but the bulk who need real help, guidance and service. The nerve centres of our activity pattern should not be concentrated only at the large urban agglomerations but should be diffused into the rural areas. Let us not forget that we are yet to provide our people with basic amenities-food, drinking water, housing and clothing.

As things stand, our architects and designers are busy making exercises for constructing tall buildings, computer-aided structures, large auditoria, huge building complexes and super highways. All these are meant only for the upper 3-5 percent of our people.

Our endeavours in the sphere of rural housing, rural roads, etc, have been most negligible. Even if we are making some progress, we have still not been able to reach the people. We must note that more than 70 percent of our people are below the poverty level. The capitalists do not depend on the purchasing power of these people for their production programmes and, according to them, the expenditure must be demand generating. But the words 'demand' and 'need' are not synonymous. A need may not translate itself into a demand because' of the inability of the purchasing power of the 'needy' people. Many of the industrialists and economists define demand as 'the effective demand' and their planning frames are often based on this effective demand. According to them, a demand which is not effective may be a need but it is not a demand for a planning exercise. Hence, they feel that the need of the people below the poverty level is a meaningless demand and thus such an economy excludes them from analysing the balance of the demand-production framework. Therefore, most of the industrial expansion in such an economy is based only on the people who have purchasing power. Construction of multi-storyed buildings and production of such goods as refrigerators, televisions, air-conditioners, automobiles, terylenes and nylons, etc, have become the order of the day worthily supporting such a kind of strategy. The present stress has been more in terms of more highways, airports, bridges, tube-rails, jumbo jets, etc, than the essential goods and services so imperative for the basic living of our common people. According to the group of economists mentioned above, the purchasing power of the upper 5 percent of our people is expected to generate a kind of activity pattern in which many more people will get tertiary employment such as servants, sweepers, coolies, maids, nurses, etc, only to serve this upper 5 percent.

To reverse this kind of so-called viable economics, a totally different kind of socialist and welfare oriented economics was initiated in the planning stage of our Fifth Five-year Plan and enunciated in the 'Minimum Needs Programme'. It was felt essential that the needs of the people below the poverty level should be met and a deliberate shift should take place from the pyramidical economic pattern in which the sweat and tears of 570 million people sustain the improved standards of the remaining 30 million people. It was further considered that emphasis should be laid on a horizontal structure of economy instead of a vertical structure. Gandhiji, as you know, also preached a similar cause — for a development having an 'Oceanic spreading circle'. The twenty-five years of economic activities in independent India have demonstrated that prosperity at the apex is not percolating to the base where 95 percent of our people are involved. The oceanic spread, as envisaged by Gandhiji, is not a corollary of apex enrichment. Hence a total shift from the so-called 'effective demand based' economy to a 'need based' economy is not only essential but also relevant if we have to fulfil the promise of equity and social welfare. The engineers, in this background, have no alternative but to shift their sphere of activity from the arena of urban economy to more involved programmes of rural areas and they should understand that industry and engineering must have to provide the required complementarity to agriculture, thus ushering a new way of life.

PLANS AND ACTIONS

The evolution of a plan over a given time horizon involves: (a) analysis and balancing of resources, both financial and material; (b) development of a hierarchy of national and state priorities; (c) development of projects and programmes for vitally important sectors within the framework; and (d) investigations of the modality of the trade balance.

Till now, there has been an artificial dichotomy between the State and Central projects where the plans for the two sectors are drawn up by separate agencies and are aggregated at a late stage; and sometimes the regional priorities are over-ruled either because of overall economic objectives or because of lack of resources. The multilevel planning process cannot bear the desired results unless the Central and State projects are inter-woven at all the stages in order to serve the objectives of an integrated development of a given region, Very often the Central projects are determined by the broad national objectives and do not adequately reflect the compulsive requirements of regional developments. The arbitrary boundaries of the States are socio-political in nature and do not conform to the geographical features and the distribution pattern of our natural resources. Necessarily, a consistent national plan has to be an agglomeration of regional plans defined by the disposition of natural resources and topographical features. The State plans should emerge out of the integral regional plans the framework of which will be the boundary conditions within which the States should operate. Today, the position is that the State projects are drawn up by different government departments competing with each other for expanding their own departmental activities in the light of their traditional experiences and objectives. Interdependence of the projects between closely linked-up departments is hardly considered. The administrative set-up of the government departments has remained unchanged since the days of Macaulay and is unequal to the task of providing a dynamic productive activity. In the colonial days, the government was interested in smoothening the market process so that private enterprises could operate without hindrance. But the nation is currently committed to socialistic objective and the key sectors of the economy have been brought under public control. The commercial and industrial ventures in the public sector are required to be effectively managed the departments. In view of these, the administratives machinery inherited from the colonial rulers urgently requires to be restructured. Unless this is done, the formulated plans can never be implemented in a meaningful way. The composition and character of the bureaucracy have got to be changed radically so that the government can adequately manage the projects involving technical complexities in the vital sectors. This requires an unhindered flow of technical judgements at the highest policy level through the induction of competent technical personnel at various hierarchial level of management and administration. Drawing up of programmes, detailing of projects, implementation of these projects and monitoring their progress will increasingly demand the involvement of competent personnel who must be provided by the engineering profession in the future. The selection of any project will require not only an individual cost-benefit analysis but an integrated evaluation process in total context. The overall economic considerations and the technical feasibility of a project are sometimes overlooked but they can surely be rectified by analysing the problems of complementarity and coordination. Unless engineers of all kinds are involved in such exercises, they are bound to be infructuous to the great dismay of our common people who are getting restless with their endless battle for mere survial.

MODALITY OF TECHNOLOGY TRANSFER

For any developing nation, the subject of technology transfer, both vertical and horizontal, is important. Vertical transfer is importation of technology usually from a developed nation to a developing nation. Very often such a transference process suffers from lack of relevance. Sometimes importation of technology places the country in a posture of perpetual dependence and becomes an agent of foreign domination rather than promoting international cooperation. The status of technology in India has come to a point where the R and D efforts within the country itself can sustain many of the programmes in which we are seeking foreign collaborations. Our present day indigenous capability, if properly pooled and guided with the necessary provision of financial resources, can fruitfully fulfil many of the national requirements, The R and D projects undertaken should bear a direct relevance to the programmes envisaged in the socio-economic framework of the plans.

Our horizontal transfer of technology within the country, which requires a regular flow of information from our R and D establishments to the people at large, has been found to be lacking much. It is essential that an effective system of interchange of technological experience should be developed between the R and D establishments (either within the industry or research laboratories) and the people using the research results. It is also very important that we should effectively process, store and disseminate the rapidly growing and accumulating technical information and data around us; but more importantly, this information should be capable of stimulating interests and demands. This necessitates: (a) provision of facilities for training scientific and technological personnel in the methodology of technology transfer; (b) development of systematic information retrieval systems at various levels of technology transfer; and (c) strategies for adaptation of technology.

The future course of action in our R and D effort in engineering is quite clear. It would be towards the development, and utilization of yet more technology so as to ensure the benefits of the modern civilization to all people while also ensuring a stable ecological equilibrium. There is no question of retreat from technological research. If there is any failure on our part to provide adequate training to a large number of engineers having diversified professional interests (some of whom are functioning at the specialized uni-disciplinary domains and many others are functioning at the trans-disciplinary frontiers) and to keep on updating them, the adaptation of technology for social causes cannot be satisfactorily achieved. This, therefore, leads us to the problems continuing programmes that become necessary for retaining and updating of the members of the profession.

MEETING FUTURE CHALLENGES

Scientific and technological revolution, even as of today, has been resulting not only in an explosive increase of existing knowledge but the need for a deeper undertanding of the physical universe. As this penetration has progressed, tools and techniques have been developed which form a new language of technical communication; and the result has been that now, as seldom before, a mere interchange of technical experience does not always lead us to mutual understanding. A catch-phrase of echoing concern expressed by many and a hot topic we have often heard: is 'How can the engineer keep himself up to-date in all of the latest happenings in the fast-palced business he's in?' The phrases 'obsolescence of knowledge' and 'half-life of the engineer', which are being used over and over again, describe the concern being felt the world over in regard to the inescapable need for the continuing education of engineers to keep them in at the growing edge of progress. In session after session, the need to bring some order into the life-long learning process for engineers is being stressed.

It is increasingly becoming apparent that many of us, practising engineers, are no longer technically up-to-date. There is evidence that older engineers are often relegated to routine tasks. Under the rapidly increasing flux of knowledge, the half-life of a formal technical education become alarmingly short.

New frontiers in engineering are developing so fast that the engineer is becoming obsolete even within 10 years after college graduation if he has not cared to make graduation the beginning of his further advancement. However, of the three major functions of higher education, namely, instruction, research and continuing education, the function of 'continuing education' is assuming increasingly critical role.

An engineer can prevent himself from getting 'out-moded'. In as much as his upkeep is made up of many factors, the problems of reducing obsolescence of his engineering skills is complex. There are no simple cure approaches which can be taken tomorrow or the next day to solve the problems. Effective solution to the problems is a time-consuming process. This time is necessary effectively initiate positive policies and practices which help will an organization.

The disregard of higher education for this responsibility is evident in almost every institution's plan for the and in the fact that when budgets must be cut, it is continuing education that is the first to go or at least the to feel the price rise, and hence the lack of worth while support for continuing education.

Some responsible technical organizations do arrange refresher courses to counteract this situation, and in metropolitan areas, school work in the evenings is possible. But these opportunities are not readily available to many of the conscientious practising engineers. Here is an urgent problem which the Institution of Engineers (India) and the industry must attack together with great responsibility and for this cause, the government should provide definite support.

The process of education should be so designed as to promote wisdom through acquirements and expansion of knowledge in order to derive the desirable qualities of mind, character and spirit so much required for continued general competence. In technology, the need for such a continuous process is paramount.

I have not only planned and initiated personally a number of such updating continuing education programmes throughout India but I have also personally conducted such programmes with a view to assess their impact on the profession. I am profoundly impressed by the feedback from these courses and I would appeal that such courses should be made a permanent feature of our activity- pattern and a 'National Engineering Staff College' should now be planned and established to coordinate such activities, particularly to encompass the interdisciplinary and transdisciplinary domains.

There are several areas, now defined enough for use, in which we should devote and forge ahead for enhanced progress with a spirit of responsible conviction and determination. Let us set upon the course to new problems with our eyes open and with our minds willing to cope with new circumstances.

Properly executed, these activities will surely offer us a means to strengthen our professional bonds and upgrade our technical consciousness. This is the idealistic goal towards which our activities should continuously strive.

I am convinced that we, engineers, have the potential ingredients to achieve a vigorous and updated Indian technology system now, and in the future as well, provided we are flexible enough to adapt our systems to our changing environment and the new qualitative problems about us.

The knowledge explosion we are now witnessing will be furthered by newer industries specializing in the storage, transfer, recall and exploitation of data and information. The population explosion' by 2014 AD is expected to crowd our world with an estimated seven billion people. And an authority has marked Friday, November 13, 2026, as the Doomsday, the day when the 50 billionth world inhabitant will be born.

Feeding and housing these people and providing for their comfort and recreation will force the engineers to design complex systems and super-systems for producing mass transport, mass-produced housing, and new water and energy supplies. The engineers will need an increasingly greater and broader background in life and in the social sciences. They will have to necessarily work in teams and share their skills with scientists, economists, sociologists and administrative experts.

The 'human equality explosion' — the drive of the world's two-thirds living in the developing countries to catch up with the living standards of the other one-third — is yet another vital issue. For example, every person in the United State now uses energy equal to 9 tonnes of coal per year. To catch up this figure for the rest of mankind will require a tenfold increase in power and energy production, and then another 100 percent boost to serve the doubled population in 2014 AD.

The constraints of an effective functioning system in the nineties will therefore be more 'human' than 'technical'. There will be sharp changes in the natural constraints and hence in the system. There will be shortages in space, air and materials. There will be longer time-horizons to be considered than in the past. But the most difficult group of constraints will relate to the need for managers in all sectors of the society-managers who can make the largest strategic judgements on a more viable stage of operations. Legal requirements, governmental pressures and the decisive interests of many of our people will have to combine together to place an extraordinary emphasis on the need for management strategies in an optimal manner.

A NEW CLASS OR CASTEISM?

Since the dawn of civilization, our peoples' progress has always been thwarted by the evils of 'casteism' of all sorts: religious, social, political, linguistic, regionalism, etc. National priorities have often succumbed to narrow sectarian interests.

Even our own profession is suffering to some extent from such a melady which is, of course, of a different nature. For example, an environmental engineer has got to emerge out of a traditional civil engineer or a mechanical engineer or an electrical engineer or a chemical engineer or a chemist, transcending the barriers of the disciplines.

Again, a power engineer is concerned with the generation, distribution and utilization of energy, but he must poise himself beyond the narrow domains of traditional disciplines. A process of integration must work in an orderly hierarchy interacting between disciplines.

Even our technical education programmes will have to be modelled towards commitment to our people as a whole and, simultaneously, they should be capable of meeting the challenges of the new order of things. Some of our super-institutions which are imitating the western styles are absorbing to the tune of Rs 30-35 crores in a Plan period, while many other institutions dispersed in the regions, the states and the universities are to remain satisfied with a meagre sum of Rs 4-5 crores for the whole Plan period. The huge expenses incurred on super institutes are creating products who look out for top urban assignments or flock enmasse abroad, while the smaller ones (some of them are century-old institutions) are very much endeavouring to supply not only the manpower required to work for the people and go to the rural areas, on the one hand; but also the manpower needed as self-reliant entrepreneurs to bear the burden of the development process on the other hand. My pointed question is: Why persue this differential strategy which is not in tune with the general socialistic outlook of the nation? Has there been any evaluation and cost-benefit analysis of this strategy? The creation of a 'new caste' amongst our profession and categorization of our technical institutions are preposterous and outmoded. I would not object the elevation of any institution if it is achieved by way of industrial collaboration or by a process of hard work and heritage. A simple process of financial pumping to create a 'class' without any assessment of the contributions of the faculties and their products to the peoples' cause, or without a cost-benefit analysis of the utilization of the costly infrastructure of their housing and equipment will surely lead to meaningless luxury in a poor nation like ours and to frustration, despair and loss of dedication within the profession. An MIT or Caltech or Aachen or Cambridge is created by a process of sacrifice, involvement and dedication and not by preferential financial pumping at the expense of the rest of the profession. If all the blood is circulated only to the brain, a man cannot become healthy. For healthy growth, a balance has to bed definitely achieved. I would appeal to our policy-makers not to overlook these factors in their zeal to create prestige symbols.

Let me quote Stephen Leacock: 'If I were founding a university I would found first a smoking room. After that, if I still had more money that I could not use, I would hire a professor and get some text books.'

George Bernard Shaw says: 'He who can, does. He who cannot, teaches'. Henry Fielding says: 'The university should not be described as fit for nothing but to debauch the principles of young men, to poison their mind with romantic notions of knowledge and virtue'.

All these outlooks formalized a kind of intellectual legacy of general and university education which have been offset by the advent of the machine age. In contrast to quote Disraeli, 'A university should be a place of light, of liberty and of learning'. The crisis today in the field of engineering education is lack of relevance of the academic curriculum. According to John Hersey, 'The baronial castles of the academic departments stand firm against the through-going efforts to rethinking the structure of knowledge'. To recall the famous saying of H G Wells, 'Human history looks more and mo race between education and catastrophe'. All these go to prove that the growing disjunction of the generations is a historical truth which is creating a new crisis that must be bridged. The growing skepticism of shadowing the possibility of objective thinking must be countered. Technical education and the profession itself can neither pursue a path of neutrality vis-a-vis the societal systems nor can go for activism by alienating itself socio-political commitments.

TOWARDS ACTION

A Presidential Address often involves an in-depth exposition of the development of a particular area of engineering, and mostly about the discipline to which the President concerned belongs. I personally feel that the President of this august body must embody the spirit and aspirations of the entire profession. There is tremendous need for the interaction of the entire fraternity towards an action programme instead of going in for the analysis of any particular area. The problem is not a mere cycling between extroversion and introversion and or objectivity and subjectivity but a involvement in the nation's socio-economic perspective. The isolation of the engineering profession has, doubt, generated an activity pattern closely tied up a small module and has become at a point, detached. It is, therefore, necessary that the aspects of interdependence and multilateral cooperation are explored systematically. It is essential that the new found technical capability of our century must live up to the new responsibilities it brings, because when fostered and applied with wisdom, it will help us achieve most of our human goals. If we turn our backs in ignorance and fear of the challenges ahead, it will mean a failure which the future generations of our common mass would never forgive.

This is precisely why I am advocating time-bound action programmes, some of which I like to enumerate. I believe that if my profession pursues these programmes in the coming years, we shall be capable of building new edifices capable of sustaining a whole pantheon of activities all around. These will include: (a) working towards a common platform for all engineers and developing an Engineers Bill in which the profession will be required to work bounded by a Code of Ethics ; (b) involvement of the profession in problems of national importance such as energy, ecology, environment and employment — leadership and guidance must flow from the wisdom of this national agency; (c) continual updating of the profession through organized Continuing Educasion Programmes and if necessary by developing a Central Engineering Staff College; (d) closing the ever-increasing gap between our people and our profession; (e) developing a positive commitment and ensuring the restructuring of our modality of thinking and operations; (f) introduction and re-inforcement of interdisciplinary Panels in order that the horizon of our profession is broadened and harmonious co-existence can result in a kind of interaction which will generate a higher order axiomatics of trans-disciplinary nature; (g) making the entire socio-political system of the country, feel that to fulfil the aims and objectives of our Plans, the engineers must be involved at all stages from conception to implementation.

Today, we are faced with cri es of many sorts: Crisis of Numbers, Crisis of Energy, Crisis of Ecology, Crisis of Employment, Crisis of Food, Crisis in Everything! But above all, there is a 'Crisis of Confidence'. In this vast country of ours, we have a mighty potential of responsive manpower, almost unending natural resources, a proud heritage and a bold and imaginative leadership which is vigorously working on a 20-point programme for the nation s economic recovery and growth. Engineers and technologists can harness out of this potential whatever is needed for societal causes, particularly for the cross-section of our people who have suffered for ages and desperately need a new way of life. Let them have confidence in us and let us have confidence in the future.

Lastly, I wish to conclude my address with the Tagore's famous poem:

He More Chitta Purna Thirthe Jago Re Dhire,
Aye Bharater Maha Manaber Sagar Tire ....

Presidential Address
(1977-78)

Engineered Effort and Energized People Essential for the Nation's Emancipation

RESPECTED RAJYAPAL, DISTINGUISHED GUESTS, ENGINEER FRIENDS, LADIES & GENTLEMEN

I am very grateful to the Council of the Institution of Engineers (India) for the great honour they have done by re-electing me as their President for the second term. I am conscious of the added heavy responsibility that goes with this honour. You will forgive me if, at times, I feel a little overwhelmed or diffident because of this continuing leadership responsibility that I have been asked to shoulder. I beseech your wise guidance and invaluable cooperation and pray that I may have the capacity to prove myself worthy of your choice and justify the confidence you have reposed in me.

On behalf of the Institution and myself, I am deeply grateful to the Rajyapal for having so graciously accepted our invitation to deliver the inaugural address of the Convention and enlighten us by his mature advice on this occasion, in spite of the heavy demands on his precious time. It is also my privilege to convey our grateful thanks to the dignitarie and our past Presidents for the honour they have done us by being with us during this inaugural ceremony of the Convention. My pleasure is two-fold: firstly because the Annual Convention has given me an opportunity to be amidst your 'roses' forgetting my worries, and secondly, because of your distinguished presence and participation in our functions affirming your faith and interest in us engineers, with whom you are so closely associated in your high public assignments. I have also immense pleasure in welcoming the distinguished guests and members of the Institution, a large number of whom have come from long distances to take part in the Convention.

On this august occasion, I like to convey, on behalf of you all, our regards and gratitudes to our new Prime Minister, the many leaders and the people who as a single team have worked together for the greater good of the country, have re-inforced its prestige in the international scene and have laid for us a new path to progress. In this context, our unquestioned morality, cultural superiority, intellectual leadership, truthful conduct, courage and determination, readiness to adapt ourselves to varying situations and more than all these, our vision and supreme confidence not to go back without justice done, have all added together to guide us into the new path and enhance its role as a great nation. In the new situation we are now placed, it is our bounden duty, as citizens first and as engineers next, to extend our utmost cooperation to the government in resolving the immense problems which have been made somewhat more difficult by our rising expectations and leading the country, through timely steps and coherent goals, to a better future. In calling your attention to this task, I am, by no means trying to ignore the 'good things' that we have already achieved so far.

A GLIMPSE AT OUR PERFORMANCE

Overall

We have considerable evidence of solid achievements which one cannot and should not belittle. There is no dearth of talent in the country and the spirit of dedication is very much in evidence. We engineers, conscious of our responsibilities, have been contributing constructively and enormously to the country's progress and, as the late Pandit Nehru has said, 'the future of the country will depend more on engineers rather than on administrators.'

The result of all this has been that engineering is in a constant state of evolution in the country. Developments related to atomic energy, electronics, space research, satellites and hybrid yields in agriculture are being achieved at an increasing pace. Simultaneously, numerous other technical advances with far reaching consequences such as automation, computers, etc are also being pursued to the extent considered necessary.

Our successive National Plans including the Fourth Plan have, to a measurable extent, helped us progressively to the next steps forward for attaining our accepted aims and objectives. Their main aim has been to accelerate the tempo of development in conditions of stability and reduced uncertainties. They have tried to introduce safeguards against the fluctuations in agricultural production as well as against the uncertainties of foreign aid. Together with programmes to increase agricultural outputs, the Plans have provided for the building of sizeable buffer stocks of our supplies of foodgrains and also for measures to stabilize the supplies and the price level in general. In regard to the financing of the Plans, emphasis has always been placed on additional mobilization of internal resources in a manner which will not give rise to inflationary pressure. We have now almost done away with concessional imports of foodgrains under PL 480, and we have tried to reduce the foreign aid debt charges and interest payments, curtail imports to manageable proportions and sustainingly increase our exports.

Obviously, the Plans have called for a gigantic transfer of technical momentum from all walks of life, specially the engineering profession and the engineers who do provide the professional leadership the country needs, and help shape a new humanism to our society.

Social Concerns

The socio-technical or scientific-humanistic programmes of the nation have included undertakings related. to urban and rural health activities, psycho-social studies of man machine relationships, the pursuit of the life sciences, etc. In all these programmes, we have been focussing our attention to specific problems relating to human conditions, such as poverty and pollution, urban reconstruction, better housing, better transportation and benign environment. We have unreservedly helped the world in gathering determination to counter the effects of harmful technological fall-out and, more positively, to anticipate and avoid such fall-outs in the future. We have been certainly widening out efforts to identify and mobilize the powers of science and engineering to enrich our society qualitatively.

Planned Agriculture

Unfortunately, when we were about to launch the Fourth Plan, things got upset again due to abnormal weather conditions, further worsened by the challenging after-effects of external aggression, leaving us in a repulsive atmosphere and shifting our emphasis from developmental activities to defence security outlays. That is how we had to work out three Annual Plans within the framework of the Fourth Plan, but thanks to the great step forward which the country took as a whole, the recovery was not only quick but stable.

The planned holiday and the consequent Annual Plans a forded a unique opportunity to strengthen our basic infrastructure and further our mission to definite ends. As hoped, the results were indeed tangible — 94 million tonnes of foodgrains, 29 million hectares of net irrigated area, 13 million kW of installed electrical power, 317 thousand pump sets, and 753 thousand tonnes of fertilizers as compared with 72.4 million tonnes, 26.3 million hectares, 10.2 million kW, 244 thousands and 344 thousand tonnes of these respectively during 1965-1966; and the number of villages provided with electricity had increased to well over 80000 in 1969 from 52 000 in 1965-1966. The area .under high yielding varieties in 1968-1969 was as much as 90 lakh hectares or a near five-fold increase over the 19 1akh hectares in 1966-1967. Technology had begun to make an inroad into our agrarian economy slowly but steadily demanding in turn programmes for progressive supplies of farm equipment and creation of agro-service centres assisted by small entrepreneurs and technicians. The total production of foodgrains in 1970-1971 set a record to date scoring the 108.4 million tonnes mark or an increase of 8.3 million tonnes over the previous year and the wheat yield reached a new high at

23.2 million tonnes in that year as against the 20.1 million tonnes level in 1969-1970. The 'Green Revolution' was on spreading its many benefits, but it was not a chance or mere luck. Ingenious applications of science and technology backed by careful planning and coupled with hard indigenous work were very much responsible for this spectacular achievement which was acclaimed by the world press. The green revolution had proved itself as a positive factor contributing to the stability of the Indian economy. What was even more significant was its impact on the farmers (even though a cross-section of them) — in rousing their interests in the use of newer techniques of agriculture and modern farming to increase productivity, as for example, through high-yielding varieties of seeds.

Industrial Growth

Adoption of a diversified industrial structure, followed by the creation of substantial capacities in many new lines during the Fourth Plan and the previous Plans, led to a fairly sound base for future growth. The industrial programmes and policies for the Fourth Plan were framed to correct, as far as possible, the imbalances in the industrial structure and bring about the maximum utilization of capacity already built up. At the same time, conditions were established for a vigorous growth in output without causing undue burden on the balance of payments of basic, critical and strategic industries covering agricultural inputs, iron and steel, non-ferrous metals, petroleum, coking coal, heavy Industrial machinery, ship-building and dredgers, newsprint, electronics and the like.

In particular, the commencement of production combined with indigenization in the Heavy Engineering Corporation, the Mining and Allied Machinery Corporation and the Heavy Electrical Projects greatly helped the expansion of the country's capacity in iron and steel making, mining and power generation. Near self-sufficiency was realized in the case of railway equipment, rolling stock, road transport and communications. The capacity for production of textiles, sugar and cement machinery was developed. Necessary design, process and engineering capabilities were acquired or developed indigenously to build industrial projects for fertilizers, rayon and paper. The production capacity for steel and non-ferrous metals, petroleum and petro-chemical industries, etc were further expanded.

The programmes of development in the industrial and mineral sectors during the Fifth Plan were also formulated keeping in view the twin objectives of self-reliance and social growth. The plan for these sectors — which includes strategies for export production, manufacture of mass consumption goods, restraint on non-essential goods and promotion of village and small scale industries — was aimed at an annual growth rate of about 8 percent and laid emphasis on rapid growth of core sector industries and application of science and technology to industrial development.

As envisaged in the Fifth Plan, bulk investments were to be made for high priority industries like steel, nonferrous metals, fertilizers, coal, petroleum and industrial machinery. While further strengthening the core industries, the Plan was also aimed at saving on imports of critical materials.

The Recent Economic Programme

In this setting to keep the nation on the move, we have just traversed a few years. Under its influence, the atmosphere in the country is, without doubt, changing to one of confidence and commitments, replete with action- oriented programmes. The society as a whole has begun to move forward energetically, to achieve a viable, self-reliant and efficient economy and improve the quality of life. With a view to giving a further boost to agricultural production, a new programme was envisaged to bring 50 more lakh hectares of land under major and minor irrigation, supported by an accelerated power programme and intensified ground water surveys; and or this purpose, the Central Government increased the allocation for irrigation and power schemes by Rs 100 crores and an additional assistance of Rs 85 crores to be given to the States. It also undertook implementation of various land reform measures which are essential for enhancing agricultural production.

With the production of foodgrains touching a conservatively estimated figure of 115 million tonnes—a record over the earlier 1970- I971 peak—around 1975, our agrarian economy was set out for a vigorous take-off. Success in bringing additional hectares of land under irrigation as envisaged is bound to spell a major achievement. As will be seen from the foregoing picture, in the realization that our economic growth is vitally linked with accelerated agricultural development, the economic programme focussed massive attention on an integrated development specially of agriculture on the basis of local needs, resources and potentialities. It also opened up some avenues for the uplift of rural areas and improving the conditions of the poor through priority measures such as moratorium on rural indebtedness, provision of house sites for the landless, land reforms, abolition of bonded labour, fixation of minimum wages for agricultural labour, etc. All these programmes were naturally aimed at making the pursuit of a more purposeful growth-oriented national strategy possible.

But Couldn't Make-up

And yet, to be factual and take a real view of things, it would, of course, be unrealistic to expect all our conflicts to be settled and all our problems to be solved in the euphoria of this victory. The country will judge us mostly by out efforts and practical results thereon. We must certainly accept that, despite our above performances, we are drowned in complexities forced on us by ourselves as well as by external forces, and it is a difficult task to sell austerity to the people who have all along suffered and sacrificed a great deal and expect the imbalances forced on them so far to be set right and their quality of life improved.

The Peoples' Plight

In spite of our country's vastness in terms of its invaluable physical, natural and human potentials, and the many big and small projects we have successfully implemented, we have not been able to make much headway in bringing an equal return in terms of practical benefits to the people. We are still in the thick of the unabating challenges and problems of our teeming millions. People have become despondent because of various setbacks in the pursuit of our socio-economic programmes. All round we are faced with a general feeling of frustration due to political, regional and linguistic differences and squabbles, a deterioration of values and loss of efficiency. We are constantly questioned whether the fantastic sums of public money that are being poured on our national enterprises are really objective and paying off in terms of readily available benefits even to meet the basic needs of the people; whether a more conscious and answerable effort cannot be put forth for the good of the people and fo give them what they need to be productive, efficient and contented; and whether we can go ahead at all the way we are going without insuring domestic tranquillity and without examining more critically and constructively the system, structure and processes we have been adopting to solve our complex problems.

It is my belief that the common man today is not by any means satisfied with what politics, science and engineering have given him. To rephrase and say he is not satisfied because there are many things that could be done for him but are not being done; he wants tangible results. The paradox is that while we are trying to spinoff our activities to compete with other rich nations, for example, in such ventures as nuclear plants, earth satellites and space probes, our average citizen still cannot get from one place to another rapidly and safely; he has to spend his precious hours in bumper-to-bumper traffic getting between his job and his home a few miles away; he has to live with his family in barely a room in an already overloaded noisy, very often deteriorating building; he has to tolerate the nuisance of garbage and trash lying around; he cannot be certain of an assured supply of drinking water, electricity, fuel and similar needs without which things cannot move on; he must keep up with an income which is woefully inadequate; he has to educate his children in the traditional way regardless of whether they are ready for it; he is made to carry the burden of taxes of many sorts; and he has to continuously queue for long hours for goods and commodities that never get to the market place. No wonder his living conditions are so miserable that both his mind and body are getting withered.

On the other hand, although we recognize the villager and farmer as the critical link between us and our agricultural sector, he has still been kept illiterate, isolated suspicious and even ignorant of things around him. Although he is the producer of our food putting hard labour in the most trying conditions, he gets even less than 25 percent of the benefits he brings to others. Even the basic amenities for living are not available to him, Mostly, his farming methods have continued to be much the same as they have been for centuries. He has yet to depend on his bullocks, wooden plough and sickle. The best help he can rely upon is from his own family. Water, fertilizers, insecticides, pesticides and other in-puts are scarcely available to him in the quantities he needs. Added to these are the vagaries of the Indian monsoon, menace of furious floods, unchecked erosion of fertile soil, lack of adequate conservation measures, etc all of which have not only been great threat to the farmer but the direct cause of irreplaceable, heavy annual losses of our agricultural yields from the precious land.

What's Required

All in all, I have cited just a few examples to reiterate that governmental action and engineering services for public welfare which involve large sections of human population placed at different levels is a formidable task, the challenges of which can be overcome only with the help and cooperation of the people themselves.

Therefore, if our society is to be made to work, if we have to make headway in solving the horrendous problems which confront us, there must be a continuing emphasis on cooperative efforts to invent new ways, new programmes and new organizational arrangements Whereby science and engineering, the arts, the social sciences, and the humanities can work in partnership and bring their resources sensitively to bear on the needs of the people.

What I am now trying to describe on the occasion, as a possible approach to tackle the problems on hand, is a kind of institution in which a constellation of collective endeavours built in with humanistic purposes.

THE PROMISED NEW DEAL

Pitifully, we ate now in a new phase of history in the face of very formidable tasks invested with a special urgency. Understandably, a major part of these cardinal tasks is economic and equally understandably, their primary aim is to remove poverty and to end the problem of unemployment which would provide the minimum needs of the people as a realistic attainment within a time span of 10 years. Yet another mission to which our new government is expected to address itself immediately is to the tasks of holding the price line and ensuring the supply of essential commodities to the people at reasonable prices, both of which are threatening to get out of hand unless immediate measures are taken to control and manage them efficiently and effectively.

Voicing concern over the price situation and economic stagnation, the government's new approach to reverse this trend and usher in reasonable stability envisages decentralization of economic and political power, regulation and control of financing of public expenditure and reorientation and revitalization of our national planning. During the 10-year time bound programme, the government will pursue an employment centred strategy in which prime importance will be given to the development of both industry and agriculture including agro-industries and small and cottage industries (especially in rural areas which have been remaining as a neglected sector creating dangerous imbalances in the economy and leading to migration of our rural people, mostly farmers, to urban areas). It will also aim at high priorities . to provide the minimum needs of rural areas and integrate rural development. No doubt the government machinery is fully pared to deal with these problems.

The first and foremost task would, however, be to clearly understand and objectively plan the nature of the changes contemplated, because the broad approach now set forth has to be converted into clear-cut, practical policies for implementation. Closely related to this issue is the reorganization of policy-planning bodies. A concrete plan of action would be therefore essential without any avoidable delay. To be brief, the government has now been called upon to shoulder awesome responsibilities in the midst of the greatest political convulsion the country baa witnessed since independence. And to cope with the problems confronting, it will need all the support and goodwill we can mobilize and all the mental and moral resources we can muster. Beyond the wildest hopes, the handling of the forces of change at work in the Indian society — which will require not only en-lightened social and economic policies but continued discipline and dedicated work from us all — and directing them to constructive channels will be a daunting job.

We 'are' Equipped

Our steps to reduce the present disequilibrium necessarily depends on the interplay of many factors and simultaneous concentration on a number of different but interrelated activities which obviously involve; basic resources, capital, domestic and external financing, knowhow, markets, manpower, management, administrative machinery, technical services (research, information and consultancy) industrial policies, technical cooperation and so on.

To construct a more effective framework to meet our contemporary and immediate future needs, one of the most urgent actions the government must take is to reduce the imbalances in society while sustaining the impact of existing technology. There is no doubt that we are sufficiently prepared for an expanded and more effective flow of technology, knowhow, capital and enterprise. We have known our resources better now and many of them have an infrastructure quite conducive to strengthening our overall base.

We are even now quite experienced in overall planning, and we have developed an appreciation of the importance of selecting viable industries instead of the previous tendency towards general self-sufficiency which is resulting consequently in high-cost production. The government as very much recognized that planning for economic progress cannot be divorced from policy questions pertaining to the three major sectors-industry. agriculture and services. Yet another factor is that we have already an established framework for international consultation to deal, when necessary, with problems that concern our national development. The government has also been encouraging many of our industrial projects to concentrate on complex and sophisticated products, while at the same time ensuring an expanding role in the production of labour-intensive and simpler manufactures, both for domestic consumption and export — a definite step in our long-term interests. With natural conveniences as a centre for containerization and stopping point for giant size ships and tankers, we have also been contributing quite well for our industrial growth and foreign trade.

Definite changes, though not to the levels one may desire have resulted from our policies for agricultural and industrial development in the number of persons employed in agriculture, industry, communication, construction, transportation, fishery and many other similar public service undertakings. Even growth in tourism has relieved the situation to a small extent. Further, our big industries like cement, iron, steel, metals, etc have been helping us to a self-sufficient level while permitting a substantial export trade which has undoubtedly kept the economy expanding.

In the course of our previous plans, there has also been a deliberate selection of projects that have potential for long-term growth. For example, the engineering and metal fabrication industries have thus been fostered. These have proved not only to be labour-intensive but 'inter-industry linkages' by which an expansion of one branch can increase the market for many others. Their products cover a wide range, from ships, aeroplanes and engines to the making of different kinds of machinery and machine components. Effort has also been made to provide infrastructure services for the above industries that have been progressing well.

Considering all these results, we cannot under estimate the complexity of a further transformation of this nature as now being desired and the frictions, both economic and social, which it must entail. Whatever may have been the outcome of our recent run-downs, it is clear that we have many opportunities before us.

But Still in Trouble

In spite of these favourable points, our market conditions have not improved and problems of unemployment are raging widely in our face. The purchasing power of the people has been so low that it has never been able to match with the increasing variety of goods on sale. Prices have been soaring all along whether they concern goods for daily use, goods used for industry and agriculture, or goods used for transport purposes. There is no difference between town and countryside in the prices. Also, the prices of the same types of goods. sold in different parts of the country are very often different, for example, as in the case of salt, sugar, drugs, oil, etc.

As rightly thought of by our new government, immediate action has to be initiated to achieve an overall stability of prices, as it will be of considerable help in stimulating the interflow of goods between urban and rural areas and also in creating favourable conditions for the expansion of industrial and agricultural production.

REQUIRES A MANY-PRONGED ATTACK—SOME FRONTS

Our Public Sector

The public sector in our economy has become an important form of participation in our industrial development, in as much as it includes large-scale industry, transportation, power, finance, commerce and so on. The government has also endeavoured to build modern, productive enterprises in the infrastructure to make the new industries the cornerstone of industrialization. We should assign even a greater role than now to this sector. However, we will surely face problems in this regard. It will be necessary, therefore, to develop proper concepts and enforce guidelines in regard to the efficient functioning of these enterprises. They must be judged for their efficiency standards and price and profit policies to ensure that they are conducive to capital formation and acceleration of the rate of growth of the economy.

Considering the importance of this sector and the need for policies aimed at efficient, balanced and profitable industrial progress, we must review the present status and lay down a firm policy of industrial development on a long-range-keeping in view their human, technical and natural resources; the new opportunities which modern science and technology have given us; the potentials of the domestic and international markets; and the scope for mobilization of domestic finance and flow of public and private capital and other related factors.

We must also give high priority to expand the infrastructure and seek to remove the obstacles coming in tile way of development: encourage more industries which can offer products to be internationally competitive and represent the most economic use of available resources; give priority to scientific and industrial research and help technology adoption to local needs; improve the training facilities; give due importance to mall-scale and medium-size industries as an integral part of the overall development programme; reinforce regional co-operation to mutual advantages giving due attention to enlarging markets; and make use of the experience already available not only from advanced and some of the developing countries, but essentially built-up on the basis of indigenous efforts.

Skills to Accelerate Industrialization

A judicious and explicit policy for using scarce domestic and foreign skills and for accelerated development of domestic skills is an essential part of our industrialization programme. Our planning must be reinforced by market forces and not to waste resources by operating with salary structures leading to inefficient use of existing stock of skills.

The training facilities available in military establishments must be increasingly used by the government in the interests of promoting small enterprises to provide them with skilled personnel such as mechanics, electricians, etc. The existing arrangements should be improved and expanded if necessary for the above purpose. Special training in entrepreneurial and managerial skills should be given to those who have been already developed as skilled technicians and enable them to establish and operate small industries through self employment.

Development Finances

We must reinforce our development finance structure by means of long-term capital, experienced technical management aids, modern investment techniques, a thorough knowledge of national conditions, capacity to appraise objectively investment risks and opportunities, market possibilities and facilities for contacts with business and investment institutions and financial and technical assistance agencies, to say the least. The allocation for development must be reviewed urgently and readjusted to bring about changes in the agricultural and industrial structure of the various regions into a near balance.

Development Banks

A number of industrial and agricultural development banks are already operating jointly with commercial banks in the country but their performance in general has been below the expected level. There is therefore great need for review and re-adjusting their policy and operations with the help of technical experts.

Agriculture vs Industry

There is hardly any need to stress that the existence of a positive and growing agricultural surplus generates sustained growth of the industrial sector. Since the criterion for ensuring an agricultural surplus depends on the rate of growth of population, the rate of advance of agricultural technology for improving living should be steadily increasing. If we are not able to meet the condition of viability of the industrial sector, we must give attention to the introduction of non-traditional factors into the agricultural sector.

Research and Development

It is well established that research and development are powerful factors in the evolution of a nation's economy, but they are expensive processes. It is important that our R & D efforts should therefore be canalized along productive lines.

The Cost of not Applying Modern Techniques

Much attention is constantly, rightly directed to the potential savings which could be achieved as a result of the adoption of the latest methods and equipment in every branch of the metal working industries. Reliable, detailed information concerning the results actually obtained from the installation of new machines and the application of improved techniques is not as plentiful as required. Nevertheless, there is ample evidence to show that the predicted economies are very often achieved and even exceeded. It is also apparent that cumulatively these economies are very large, and that they could be greatly magnified if there is more readiness on the part of many factory managements to intensify the pace of modernization of production methods.

At the same time, it is clear that if substantial savings are being obtained in many directions in those instances where a progressive outlook prevails, losses of a very high order are necessarily being incurred by those. companies which continue largely to disregard the advances which are being made in connection with manufacturing procedures.

We are already aware of what has always seemed to us to be, a classical example of the effects of an inherent resistance by many of our industries to new methods which appears to prevail widely. For example, although the advantages of throwaway tip carbide tools have been established beyond all argument, they are being largely neglected by a great majority of firms. The general attitude in this respect is difficult to understand because any sizeable company concerned in metal working could at least carry out trials with these tools for a very low outlay and with virtually no interference with normal production. We must therefore immediately enquire into the present annual losses we are suffering on these accounts.

There have also been losses due to delays in applying certain other selected techniques such as: NC machine tools, improved drilling cold extrusion. finish blanking and piercing, and reaming.

The slowness with which new methods are accepted by industry at large, despite all evidence of their economic advantages, is perhaps due to what has been termed the HIP barrier. This barrier is composed of factors which rail into three main groups, associated with history, incentives and psychology. It has not been substantially overcome in many countries like ours although the relative influence of the three elements differs in different countries.

The basic scientific knowledge and principles developed in our national laboratories and major industries should therefore first pass through applied research and development processor. From this stage, technologically possible techniques must emerge, and these must then be subject to the economic filter. Beyond the latter will be those techniques which are both technologically possible and economically desirable. Before they can find extensive application in industry, however, they must also pass through the HIP barrier.

This is the barrier which is giving rise to built in attitudes affecting change, particularly rates of change. To overcome this, it is necessary to try to solve the problem of how to establish a worthwhile incentive without involving intolerable expenditure. In this connection there must be a special communication system which can promptly transfer valuable information derived from research into the large number of varied case histories of change already on our record.

It is evident that the obstacles to more widespread adoption of Improved techniques are very formidable, and It IS, therefore, clear that more attention must be directed towards overcoming them if the continued cost and effort of developing such techniques is not to be largely wasted. One of the more effective lines of approach In the immediate future which we should forthwith take is to arm for numerous individual penetrations of the barrier which, though small, are permanent and can frequently be enlarged.

Large-Scale Production and Small Exports

Under conditions of stiff competition, large-scale production has considerable advantages over production in small-scale industries, because large-scale enterprises can reduce the investment layoffs per unit of output; and apply modern production techniques and rational forms of organization, thereby increasing labour productivity and efficiency and reducing the prime costs of production. However, in establishing the optimum scale of such an enterprise, another basic factor which we should consider is the extent of demand for its products. The economic advantages of such production are already very evident in our electrical, metallurgical, chemical and other branches of heavy industry.

However, we must take care to see that large-scale production will not lead to an imbalance and 'kill' the small and medium-sized firms. Although our existing small-scale industries and handicrafts are producing goods mostly for local consumption, they are also getting export oriented now; hence, they should be the largest group in our manufacturing programmes in terms of enterprise. Also, there is an urgent need to quickly modernize them, preferably by indigenous efforts, along lines of production organizations, so that they can yield outputs at their optimum capacity.

Diversification of Industry

One of the main question related to our programme of industrialization is whether we should further develop light or heavy industries first. Of course, both these types have positive and negative features and we must consider them as per our necessities.

Our industrialization process is trying to stop imports as much as possible; in other words, it is seeking to substitute semi-domestic products for imported goods. However; we must remember that the substitution of locally produced goods may not be economically justifiable always. When implementing a policy to create import substitution industries, therefore, considerations other than comparison of direct costs with expenditures on imports should be fully explored. In the interest of diversification, even though are fully equipped by ourselves to carry on the job, we must re-consider foreign economic ties, when absolutely necessary.

Fiscal Incentive Schemes

We must take urgent steps to evaluate the impact of our existing fiscal incentive schemes and study whether these schemes are bringing about results expected of them, particularly regarding the increase in investment in the priority sectors: whether the industries which are actually deriving the benefits of tax concessions are the intended ones; and whether the administration of the scheme is adequate. This evaluation should be made regularly to ascertain the real priorities required from time to time and adjust the tax concessions to industries accordingly.

Manpower Policy

We should plan and pursue an active manpower policy not only to contribute to full employment and increasing economic growth but also to sustain economic balance in the labour market. Such a policy can, through adequate measures, contribute to reduce the problems of availability of labour for jobs or regions where shortage of manpower tends to raise the wage levels. This must be achieved by adopting schemes which will increase geographical and occupational mobility or through measures which can help better utilization of scarce resources by using less skilled labour of which there is no shortage in the country.

Outputs and Employment

Although the primary aim of industrial development is to increase the output and income, it is wholly meant to provide jobs. All the same, in our background, we should ensure that this development will not leave many people without work, or more importantly, that it provides many new jobs quickly, using the country's human potential as fully as possible.

The Government has a great obligation to do all in its power to provide more types of productive work for those who need, it; and all the States and the various organizations, industries, etc both in the private and public sectors should be directed forthwith to declare and pursue as a major goal an active policy designed to promote full, productive and reachable employment for the sake of the people.

SOME MEASURES TO COMBAT UNEMPLOYMENT

Although we have been trying out a wide range of measures to counter the unemployment problem, there is very urgent need to extend and adapt them in a selective way in accordance with our circumstances. For the most part, the present unemployment situation is the result of our conjunctural movements and changing long-term structural relationship in social and economic life. What we need in consequence is short-term measures to facilitate the long-term changes and moderate the inflationary pressures. We must also supplement coherent policy strategies which effectively act on the envisaged relationship in our social and economic growth and employment.

As regards, the conjunctural movement, since the success of active manpower policies depends on our general economic environment, the government should continuously review the adequacy of measures which are now in existence to create work, maintain incomes and spread the burden or unemployment more equitably. An Inventory of practical measures to deal with the more urgent aspects of the employment situation should also be developed immediately.

To maintain employment, the government should, as mentioned above, encourage spreading of the burden of the reduced employment through more equitable work sharing and short time work. Steps to the extent possible must be initiated to provide unemployment benefits during partial and complete unemployment and industries and other employment sources should be asked to notify their redundancies much in advance. Provisions for additional training or general education should be made for the unemployed.

To maintain and increase employment, definite actions are necessary. It is often less costly to maintain employment than to provide adequate income support for unemployment. Among the means to tackle this issue selective support of private employment through direct subsidies and other fiscal incentives, promotion of new investments and shifting the incidence of payroll taxes are important means. However, these measures have their own constraints which include the costs of holding inventories, marketing factors and the need for sectoral adjustments. Still a more equitable spreading of the burden of unemployment may partly be achieved, as said before, by work-sharing arrangements, shorter hours and part-time work instituted by employers or through agreements between unions and managements.

To create employment in the public sector, there are three major methods:

(a) Temporary expansion of employment in the regular public service — this can improve the provision of services and decreases outstanding backlogs, but it would be necessary to ensure that the extra funds are used not simply to finance regular employment but to create additional jobs which will primarily benefit the unemployed.

(b) Expansion of public works to create employment in public and private sectors — the need to develop work quickly suggests an emphasis on labour-intensive projects. Time limits on the availability of funds should be enforced to stimulate quick response by local and regional governments. We must also give due consideration to stimulating public housing construction and repairs since there is a growing gap between needs and construction and this will help to strengthen the base to solve our unemployment problems to a degree.

(c) New initiatives to create community employment — more jobs must be created at the local levels of the government, by non-profit institutions and by groups of unemployed people themselves. These programmes have proved to be labour-intensive arid can be expanded relatively quickly, employing the young unemployed in particular, as well as other less competitive workers in ways .that will provide new and imaginative services to tackle social needs which are not being met by other means.

Other Steps

Our public employment services may be asked to simplify their administrative procedures and undertake more intensive placement and counselling especially about training and job opportunities.

Manpower Training

This instrument should be further expanded reasonably quickly, particularly in the background of our increasing capacities in the education system and enterprises, so as to absorb a growing number of unemployed. It should be oriented towards improving the employability of Individuals and facilitating anticipated changes in the economic structure.

Policy Coordination

Rising unemployment combined with high rate of inflation and complexities of interdependency in the country are pressingly calling for increased coherence and coordination in both the development and Implementation of economic and social policies. Our policies should be fully coordinated and improved to ensure an effective harmony and make them amenable to both general and selective policy instruments.

A Policy for Working Life

The government should take affirmative actions to improve the quality of working life, laying major emphasis on the goal of personal fufilment over and above the technical and economic requirements of production. This policy should include: development of more clearly defined criteria for job assessment; merit reward and salary scales; job enrichment; increasing flexibility of work and careers and the organization of working days and weeks; greater worker participation in decisionmaking; and provision of opportunities for career development and training on a more equitable basis. The public sector, in its recruitment and promotion policies, should take up the initiative in this area immediately. This type of development depends considerably on changes in attitude on the part of both employers and unions; therefore a more positive action must be pursued by the government to facilitate this.

We are well aware that many young persons are facing problems in their careers because they lack both formal credentials and specific training which are now required for skilled jobs. Their problems have been complicated because of the attitudes of many employers who are adamant that those who apply to them for jobs must satisfy the above criteria as well as a stable work history and settled family life. This seems to be too much to expect.

Another group of young job seekers is composed of those who show independence of spirit in searching for varied and meaningful human experiences, and as a consequence, they are discriminated against by employers. As such they also have difficulties in resuming formal education and training. To offset this problem a basic-change of attitude is needed on the part of both employers and educational authorities. The employer must realize that it is sometime the more able who follow such non-routine patterns.

Wage Policy

Success of the country's efforts to promote development will depend partly upon the level, structure and rate of increase of wages and salaries. Such a policy is necessary to decide firstly the kind of wage movements the government will encourage or discourage, and secondly, the instruments it will use to influence the wages.

We should therefore adopt a national wage-policy to be able to exert an influence over the rate of investment, level of prices, balance of payments and volume and structure of employment. These aspects are no doubt influenced mainly by the monetary and fiscal policies, but our decisions affecting wages will also matter. The wage level should take due account of our capacity to pay, meet foreign competition at home and export markets, and provide productive work for a rapidly growing labour force, both unemployed and under-employed.

Practical problems may confront the government as to what should be the optimum wage level for the country, and what room is there for wage increases in our difficult situation. The main source of wage increase should therefore be increased production on the many fronts.

If the government decides in the national interest to adopt a wage policy calling for some forbearance on the part of workers to the pace and requirements of our economic growth, such a policy, to be acceptable, should incorporate firstly an equitable fiscal policy to ensure that any wage restraint is matched by a similar restraint on the growth of other incomes, and secondly, also an effective policy to promote economic growth for which the wage restraint should be imposed.

Food Storage and Handling

Outmoded and unsatisfactory practices followed in our storage, processing and transport of food industries have been causing immeasurable losses to the nation. The result has been that the estimated loss of raw and processed food products by spoilage is as high as 20-30% the loss through rot vegetable and fruit about 40% and poultry products about 30% most of the fish caught in some regions are found to be unfit for consumption and are sometimes used as manure for the land and more than 10% of all grains, pulses and oil seeds are getting destroyed by insects, rodents and fungi.

This problem is therefore collossal and to tackle it, we will require not only advanced technical and practical knowledge to a great extent but an extremely efficient management control communication and distribution system spread out in a network through the country.

Science and Technology Policy

Our science and technology plan must, under these circumstances, investigate the various trends which affect the result of political and managerial decisions in the fields of science and technology; why some inventions successful, while other similar ones are not and how are technological trends affecting our manpower demands, etc.

To investigate the effects of changing technology on the industry's employment and training requirements, we must forthwith establish an early warning system which could screen the changes in technology and identify those with significant employment implications, and search for discontinuities which might permit extrapolation of the trends, etc. It is equally important to know which changes could probably be ignored as unlikely to lead to major disruptions.

Changes in materials technology (for example, plastics and carbon fibres), in product technology (for example, micro-electronics) and in managerial and organizational techniques (for example, group technology) should all be investigated in greater detail than now. However, it is more important to concentrate on some specific fields: for example, changes in manufacturing technology including design and drawing.

The existing manufacturing technology in practice in the country should be classified into processes and the changes in technology into groups such as: those changes which result primarily in the growth of an existing processes or in the introduction of new ones; and those which result in changing labour requirements, such as automation. In general, the first type of change seems unlikely to generate employment problems.

Some of the more general trends seem likely to generate employment opportunities. For example, metal forming processes, powder metallurgy, die-casting and plastic moulding are all bound to grow faster in the machining processes. These growing processes are relatively large and our increasing demands on tool-making will naturally necessitate increasing supply of skilled labour.

Automation is likely to cause major employment changes. In foundries and machine shops and fabrication and assembly, the probability of rapid automation of handling and control is quite high. The automated assembly is attracting a great deal of development effort everywhere but a major impact on the labour force seems unlikely presently. On the other hand, with mechanization and automation working together, as in a foundry, the effects on employment trends will be surely encouraging in the machine shop; however, automation alone raises questions about employment. It is therefore better to fix our attention on small and medium batch production.

Rural Development

The growth of agricultural production is essential to an efficient rural aid programme which go well beyond. The approach to its problems is a comprehensive one in which the key element is the large-scale integrated project. Aid-financed projects of this kind should be implemented by us to overcome the difficulties now being encountered, which include dismissal of farm tenants as a result of mechanization, a decline in agricultural prices due to increase supply, difficulty of reaching small farmers in an economic structure favouring large-scale farming, imbalance between social and productive activities, and distortions in favour of the region chosen for the project. These problems can be corrected and an integrated approach must be emphasized by the government.

Drinking Water

Immediate consideration must be given to development aid programmes for water supply for agriculture and rural development, for irrigation and stock breeding. So far, we have given scanty or very little attention to this vital aspect.

Housing and Urban Planning

Our demand for inexpensive housing is very great, and the solution of this problem is closely linked with other aspects of social development. High building costs and high interest rates have been forcing out even the most modest housing beyond the reach of our lower-income and middle class groups.

Intensive research further to that already being done is at once necessary to perfect techniques of low cost housing construction which are specially adapted to the climate, materials and social needs of the country. They should be labour-intensive and should make use of local materials as well as economies of scale and modern building technology. Sociological research is also necessary to ensure that the housing projects really involve the concerned income groups. If we depend on foreign aid for this purpose, the project is sure to run into obstacles.

Materials research should be given extra impetus to develop a high speed building system specially adapted to our needs and it must help us in building rapidly and at low costs and using large panels fabricated on the building site itself rather than in factories.

Local Technological Traditions

Successively generations our craftsmen and farmers have accumulated an immense stock of knowledge and knowhow, but these technological traditions are now rapidly disappearing, largely as a result of our development of modern industry. Without trying artificially to preserve the past and turn the rural areas of the country into technological museums, it is very important to use this knowhow as a basis for further innovations: for example, the art of the village blacksmith can be very useful in making small-scale agricultural machinery and the art of the potter in constructing irrigation and water supply systems.

Need for Local Initiative

Our scientific and technological system is highly centralized administratively and very concentrated geographically, but as experience shows, clearly decentralized systems will be more conducive to innovation and for stimulating the entrepreneurship and initiative at local levels. This aspect must receive definite attention.

Intermediate Technology

Promotion of modern large-scale industries is necessarily costly in economic and social terms and tends to benefit our people living in cities while doing little to meet the basic needs of the rural communities. The use of 'intermediate', 'low-cost' or 'appropriate' technology, which has been proving that it can create labour-intensive activities on the spot will be of much help to solve this problem.

Intermediate technology has already aroused considerable interest on our part as an effort to avoid two extremes in our development strategy: the massive import of foreign technology regardless of its suitability for local conditions, and complete rejection of this technology. Intermediate technology does not, however, exclude the use of capital-intensive or sophisticated technology when appropriate; but attempts to promote a parallel development of labour-intensive projects which are relatively simple be well adapted to the social and economic environment, making use of the inventive and innovative capacities of the local population.

Our ox-driven plough is a good example of intermediate technology; it stands, as experience says, halfway between the traditional hand-operated tools like the hoe and the modern machinery like the tractor. If we are able to develop the solar pump using appropriate technology, it is possible to harness a widely available source of energy, namely, the sun, to supply our villages with much more water than our ordinary wells are supplying. It would be of interest to try the system of water purification (developed in Thailand) using rice and coconut husk (which we get in plenty), which would otherwise be thrown away; this is an example of low-cost or even zero-cost technology.

The technology we use for agriculture must also be simple and easily accessible — when it concerns, for example, the preparation of the soil. No doubt, the present heavy tractors and mechanical implements do yield rich results, but the pity is that our impoverised farmers cannot by any chance own them individually or run them efficiently all by themselves. Therefore, it seems, such advanced technology will have limited relevance to our agricultural practices at least for some years to come. Such being the case, it would be prudent on our part to continue the practice of tilling the soil by the age-old bullock-ploughs but equipped with an improved system which can reduce the burden on the animals and increase their tractive effort at the same time. The use of horse collars instead of breast bands on the animals has led to revolutionary results in agriculture in many parts of the world. Such implements are urgently needed in our country and based on the technological level required for local manufacture as well as to the type of raw material used, there are good possibilities for such local manufacture. However, the main problem for local manufacture is the lack of products for adaptation and the expertise necessary. There is a need to secure the assistance from appropriate developing countries which are manufacturing successfully such items can help us through transfer of technology. Small pilot manufacturing facilities could be established immediately at suitable places in the country for the manufacture of selected simple implements with the assistance.

Another area of equally great importance is the supply of science-based techniques, even more than now, for improving seed quality which can improve agricultural productivity.

Use of mineral wastes for soil reclamation offers a fine opportunity in neutralizing acidic and alkaline soils, minimize soil reclamation expenses and convert such reclaimed lands for agricultural purposes. The production and use of *gobar* gas is one more example of this sort. Again, the cellulose materials which results as a product of agriculture in large quantities, which is nearly similar chemically to carbohydrates can surely be reconverted for human or as an effective animal nutrition if only the technologists apply their mind.

Although the concept of intermediate technology has only become current within the last few years, its underlying philosophy is much older. In fact, in our own country, the policy of promoting intermediate technology originated in the Ideology of our great social reformers like Mahatma Gandhi.

Wider development and use of appropriate technology necessarily call for greater coordination than now with our national policies for science, technology and industry, although many of our practitioners are somewhat sceptical about the role which governments can play.

SELF-HELP INTO THE FUTURE

To sum up some of the salient points of what I have just said:

In a country like ours in which the majority of the rapidly growing population have to earn their living mostly from agriculture prime consideration must be given to the creation of more and more related agro-based workplaces, Since unemployment and a shortage of capital have now become the order of the day, we must try to develop newer concepts. The greatest production reserve of the country is its unutilized manpower, and giving the manpower a permanent workplace will require further strengthening of the country's ability to help itself. This points out that labour-intensive and capital-saving production methods will be particularly suitable tools.

Most of our villagers are too under-developed for technical progress. If, therefore, we use already familiar and immediately available aids, we can certainly lighten their heavy burden. They would then have more time to learn how to improve. This can surely lead to an improvement of their social status. The battle against unemployment and under-employment is an important feature of our policy-making work. The promotion of industry should, therefore, be a priority task. It should however not benefit our export trade alone but our domestic needs first and foremost. The government should, therefore, try to encourage technically relatively simple small and medium-scale industries and artisan enterprises which can employ a comparatively large number of people and need little capital.

The country should develop and acquire for itself more technologies which will allow the processing industries to utilize domestic raw materials and energy sources to save foreign exchange to a greater extent. In: order to avoid grave differences in income, we must also create opportunities for employing workers who have no specialized training. To enable this, we must develop plants that can manufacture small numbers or quantities of products at low cost as an alternative to unprofitable production with imported plants. Robust products that are easy to operate and repair can help balance out our shortages in skilled workers and workshops.

Our research and innovation should be extended to cover wider fields from simple agricultural technologies to the adaption of modern technologies connected with energy, raw materials, water and food supplies.

We must realize the greater benefits of developing labour-intensive technologies. An increase in the number of smaller and medium-sized firms, as mentioned before, should be given immediate consideration: these may, for example, include, clothing industry, electrical industry, precision. engineering, optical and clock industries, textile industry, iron, sheet metal and goods industries, mechanical engineering and wood-working industries. They must be made responsible to select and undertake manufacture of products which would ensure high levels of employment.

In order to curtail imports of equipment and machinery, whether highly modern or simple and built them ourselves, the government should grant production licences at more favourable terms and with no strings attached.

Since our economic growth will ultimately depend on the effort, knowledge and skills with which we can utilize our human and material resources, we should give greater assistance to these causes through sound internal technical and financial assistance policies.

Investment being the main propellant behind economic development, we should attract the capital we need by improving conditions for private investment.

Since the operation of free and fair markets is the best way to increase production, improve efficiency and stimulate growth, we should try to open more international markets rather than impair their operation by adding new restraints and controls—either governmental or private.

In tackling our problems to achieve quicker practical solutions, we must avoid facile generalizations. Since each commodity and each industry is unique, our debtor balance-of-payments, market structure of specific commodities, investment requirements of each Industry, etc should all be dealt with on a caseby-case basis.

Decisive measures to bring about parity between the important factors-capital and labour—should be tried as a continuing task to achieve the goal of 'comanagement' which gives the right to the concerned to participate in those decisions of a concern which can have effects on the safety of the workplaces, and the right to be heard in at least minor questions of everyday working life.

Our social development must be consistent with an economically viable balance in the society between leisure, work and education. The government, unions and employers should work together in order to agree on how the costs and benefits should be allocated and to decide what underlying institutional arrangements will be needed to make greater flexibility, possible.

These new life patterns will not emerge by themselves. It is the main responsibility of our public policy, in conjunction with the social partners to define the instruments that would provide the' possibilities of and the incentives for individual and institutional changes. The most powerful instruments that will aid this are: a re-definition of the rights of the individuals on the one hand, and provision of the financial means to make these rights a reality on the other.

Naturally, no adequate answers can be found unless we bring the world of education and the world of work closer together. This means, that the social partners must have a voice in policies and must be ready to take on new social responsibilities. Some advisory machinery at national level is therefore clearly needed to deal with the range of issues involved,

I can go on with more points, but I am sure there is no need for me to do this, for the above few aspects which I have tried to stress will suffice it to indicate the extent to which we should still go.

CRISES HAVE ROUSED CONSCIENCE

As would be clear from what I have already covered so far, the crises of the past years have all intensified the conscience of our public. The government is once more confronted with the necessity of thinking out a more beneficial socio-economical programme for the nation. There is also a compelling logic for this thinking, but the aim of achieving the actual results requires considerable effort on the part of all of us in whatever walk of life.

The most alert minds are actively at work to study and give a new direction to the forces of the new voice of our people which demands reasonable chances for: overcoming their vexing critical situation; acquiring the moral direction, indeed fresh enlightenment and illumination, powerful enough to lead them to a better future in which their rights, which gives them independence its intrinsic value, will be protected; and participating in the history-making of the country, not only in a suffering and patient way but also creatively and consciously. In this background, any new action thought of will still be an experiment in human affairs on which a beginning has already been made but the progress has not been much so far.

Need for More Flexible Life Patterns

If therefore people are to have as much freedom as possible to organize their lives and career patterns an undesirable conformity should not be enforced by the regulation of public agencies and private enterprises. The financial and institutional relationships of employment and recurrent education and other related personal Issues should be reviewed by the government in order to remove unnecessary impediments to individual choices. At the same time, the economic implications of this cannot be ignored.

CHALLENGE OF INTEGRITY

Almost everything we see around us has had the magic touch of engineering — which takes Ideas and brings them into the fruition of materials of power, products and machines. These have been made possible by the application of engineering principles and cost-reducing projects. The engineer and the technician are thus involved on the battle front of economic feasibility. Unfortunately, the greatest progress in these areas has been made by a relatively few on the distribution curve. The rest have ridden along complaining about not having opportunities and not being appreciated. This holds true not only for the engineer, but for industry, educational institutions and technical societies.

Hence, the success which attends our efforts as we are envisaging in the new deal for the nation will be determined by the paramount challenge of integrity. This is the greatest challenge of all because it gives meaning to every other challenge. Another indispensable for the success is obviously technology but it has no moral purpose by itself-sit is we who must supply this. Instead of merely being content that we are on the march technologically, it is we who must show that we are on the march towards the goal which our own integrity and moral purpose have assigned to it. The more mechanical we become with the weapons with which we fight, the less mechanical must be our spirit which controls them. And it is we, engineers and scientists, who are uniquely placed to supply that integrity and spirit to our nation.

A VITAL TASK AWAITS US

Technology, as I just said, is a pervasive mover of society and the problems of the society are unsolvable without the engineering approach. As men required to apply technology actively and even aggressively to the business of living, we engineers who belong to a great country and in it to a great Institution have a great social mission — an obligation of sharing with everyone else the responsibilities of fulfilling the needs of the society to make life safer, longer and richer. Fortunately, our profession has a rich heritage and a glorious tradition which the past has bestowed upon us. While preserving and enhancing that heritage, if our profession has to contribute to the future in the same or greater degree than it has contributed to the immediate past, we must of necessity continue to light our way through many challenges and environments, however complex, demanding or rigorous, for it is our very way to be creative and purposeful.

We are now amidst one such challenge — rather a unique opportunity thrown to us — which behoves us to give our nation the best of our energies and talents and to ensure that our engineering will remain ever vital and indispensable in combating the obstacles that are thwarting our peace and progress.

The Council of our Institution fully recognizes the enlightened guidance and new directions that are being given by our government to the nation in its new disciplined and determined march to reach the envisaged goals of eradicating poverty, solving unemployment, enhancing productivity and thereby ensuring alround national development through self-reliance. In this gigantic task of fulfilling the aspirations of our changing society and achieving for its new dimension in the commity of nations — which, of necessity, calls upon every individual to contribute selflessly his very best to the many pronged economic, social and technical programmes now contemplated by our national leaders. We, of the engineering fraternity, are not only fully conscious that we are in many ways instrumental and responsible but we have a crucial role to play. In a situation as at present and in keeping with our rich heritage let us pledge our wholehearted and unstinted support to the dynamic leadership of our Prime Minister in carrying on the task of accomplishing the new programme for the welfare of the people.

With the conviction and avowed faith that engineering has a great lot to contribute to our continuing battle to rise our national status and prestige, let us further pledge, with all dedication, that we will serve our total strength at all times and on all occasions to the government in its relentless, diverse endeavours to serve the people of this great country.

Prof Dr A Bhattacharyya—a Brief Profile

Prof Dr Amitabha Bhattacharyya, BME (Hons). ME, MS (Illinois), PhD (Eng), PRS (Cal), MIProdE (London), CEng (UK), Mem CIRP (Paris), FIE (Ind), a distinguished mechanical engineer, an eminent educationist and Chairman, International Committee on Education and Training of Engineers of World Federation of Engineering Organizations (WFEO), a reputed scholar and researcher and an acknowledged authority in the fields of production engineering, metal cutting and machine tools, who has been honoured with many coveted national and international awards for his outstanding contributions to engineering and thereby to humanitarian services, has been elected President of the Institution of Engineers (India) for the Session 1976-77. Succeeding Dr V M Dokras, the retiring President, Dr Bhattacharyya will take office at the 56th Annual Convention of the Institution at Ahmedabad which will be inaugurated by Dr G S Dhillon, Union Minister for Shipping and Transport, on January 18, 1976.

In the background of his remarkably impressive records notwithstanding his young age (Dr Bhattacharyya was born on 12 November 1931), he brings with this new attainment not only a justifiable pride to engineers in as much as that he is the youngest and one of the most radiant among those who have, risen to the office of President since the inception of the Institution over five decades ago but a lustre to the engineering profession and the Institution, of which he became an Associate Member in 1959, a Member in 1968 and a Fellow in 1971.

Dr Bhattacharyya's election has indeed come as a momentous recognition of his dedicated and towering personality. Of course, the cordial and unassuming Dr Bhattacharyya — who, with indispensable influence, uncommon warmth of spirit and unconditional, selfless devotion, has been so indelibly contributing his efforts over the years to achieve a new dignity, understanding and acceptance for indigenous engineering far beyond the Indian frontiers — is already very familiar in the profession where his engineering eminence, exceptional skills, expert leadership and dynamic accomplishments have won for him great love and esteem. A man of wide-ranging and original expression, is forte covers a vast field and his experience encompasses a wide spectrum — from engineering education and research through planning and development work to administration and management. Officially he holds a dual assignment he is presently a Member of the State Planning Board, Government of West Bengal and also continues as Senior Professor of Mechanical Engineering and Head of the Production Engineering Division of the Jadavpur University.

Following a brilliant academic career replete with many super-firsts and superlative ovations Dr Bhattacharyya has devoted the major bulk of his years with immense vision and vitality in the halls of learning where he has served and contributed most significantly by developing and directing a variety of advanced academic and research programmes for the graduate, post-graduate and doctoral engineering levels and by steadfastly counselling, stimulating and inspiring his students and colleagues to new ventures, which have provided the rich ground to make Jadavpur one of the distinctively great engineering faculties in the country. He has involved himself heavily in similar educational activities at the international level as well; and in this background, he has been honoured by the Pennsylvania State University, USA, as its Distinguished Visiting Professor — a distinction which he is the first Indian engineer to receive. His fertile experience as a Visiting Professor has also been requisitioned unceasingly by several renowned engineering universities and faculties like the Technical University of Srno, Czechoslovakia; the Olivetti Research School, Italy; and similar others in Europe and America. His intellectual excellence and unique achievements have brought to him the Chairmanship of the International Committee on Education and Training of Engineers for the term 1975-78 to which high office he has been the first Indian to be unanimously chosen by the World Federation of Engineering Organizations at its Fifth General Assembly at Tunis in June 1975.

Through pioneering studies and I stupendous personal involvement, he has exercised great leadership in flourishing research programmes which have won him national and international laurels, specially in recognition of his studies, strategies and innovations in the fields of production engineering, machine tool technology and metal cutting. Reckoned as an authority and heavily drawn upon as a consultant-expert on technological problems in the above fields, his precious advice and findings are benefitting not only the manufacturing industry but numerous research organizations and academies both within and outside the country. Hailed and acclaimed for the simple and sustained narrative sense that characterizes his work, he has been honoured by the

International Institution of Production Research (CIRP) at Paris to its Council membership, where he has been playing a leading role.

A persuasive teacher and an eloquent speaker gifted with an extraordinary charisma to master those playing under his baton as well as those listening to him, Dr Bhattacharyya has widely travelled in the UK, the USSR, the USA, the Continent, Africa and Japan in connection with many professional and academic assignments. He has not only an admirable record of continued participation in national and international conferences and forums organized by world bodies like the UNESCO, UNIDO, WFEO, CEC, CIRP, etc but has been consistently contributing to technology, with a vast number of original research papers, specialized lectures and course directions to his credit. He is also the author of several authoritative books, treatises and monographs in his chosen fields and related interdisciplines which have been translated into several languages.

Dr Bhattacharyya is a member of many specialist councils and professional societies the world over, but seen from the vantage point, his active, rather stubborn, interest in the Institution is particularly fascinating. Projecting his wisdom in all its ripeness and his masterly ability to organize and manage, he has been a dominating force relentlessly at work adding to the gaiety of the profession immeasurably. With an enormous wealth of ideas always in play, he has been a staunch champion of the Institution serving the Council and many of its important committees and panels for long. He is a member of the Council since 1964, was Chairman of the Bengal Centre during 1974 and has been Chairman of the Mechanical Engineering Division during 1973-75. He is also Chairman of the Production Engineering and Machine Tool Technology Group. He was a member of the Finance Committee during 1967 and 1974 and has been a member of the Engineering Education and Research Committee (now called Committee for Advancement of Technology and Engineering) since 1966. Besides these, he has had a prominent role in a number of other action oriented committees such as the Journal Review Committee, Headquarters Re-organization Committee, Syllabus Committee, Image Committee, etc, formed by the Council.

A challenger who has swept through gruelling situations with a mighty display of ingenuity and action, he has been instrumental in inspiring, directing and implementing, under the auspices of the Institution, a variety of on-going technical activities and learned society programmes such as round-tables, paper meetings, continuing education courses, seminars, symposia, etc in many new and sophisticated areas of mechanical engineering at both regional and national levels.

Dr Bhattacharyya is also associated with various other bodies outside the Institution. To recount the prominent among them, he is a member of the National Committee for Science and Technology of the Government of India and the Member-in-Charge of the Committee for Science and Technology in the State of West Bengal. In addition, he is a member of the Education Committee of Commonwealth Engineering Council (CEC) and a member of the Governing Council of the Central Machine Tools Research Institute, Bangalore. Further to these, he is a member of the Scientific Advisory Committee of the Central Mechanical Engineering Research Institute, Durgapur; at member of Machine Tools and related Section Committees of the Indian Standards Institution: a member of the Jadavpur University Syndicate and a member of the National Council of Education, Bengal. In the professional sphere, he is a member of the Institute of Production Engineers (London); a member of the Indian Society of Theoretical and Applied Mechanics; and an Associate Member of American Society of Mechanical Engineers.

Dr Bhattacharyya was bestowed the Shanti Swarup Bhatnagar Award for 1971 by the Council of Scientific and Industrial Research, in recognition of his conspicuously important and notable contributions to human knowledge in his special field of mechanical engineering and the Rs 25.000 FIE Award at Bombay for his outstanding endeavours and achievements to mould engineering and technology to serve humanity. He is also a recipient of the Mowatt Gold Medal from the Calcutta University and the President of India's Prize, the Sir R N Mookerjee Gold Medal, the Chandra Prakash Memorial Prize and the K F Antia Memorial Prize awarded by the Institution.

An active and constructive social worker too, he has ardently identified himself with the aims and aspirations of numerous civil and cultural organizations and has been serving them with great distinction.

The profession brings in him a many splendoured personality and a selfless leader whose dynamism, we hope, will lead the Institution to greater heights in fulfilling the nation's cause.

Lt Gen J S Bawa

PVSM, AVSM

Engineer-in-Chief, Indian Army

President 1978-79 & 1979-80

Presidential Address

(1978-79)

The Role, Image and Responsibilities of Engineers

YOUR EXCELLENCY SHRI L P SINGH, DISTINGUISHED PAST PRESIDENTS, DR A BHATTACHARYYA, HONOURED GUESTS, LADIES AND GENTLEMEN:

First of all, I wish to express my grateful thanks to the distinguished engineering fraternity which has done me the honour of electing me as the President of the Institution of Engineers (India) for the session 1978-79. I wish to assure them that it will be my endeavour to prove worthy of this honour and of the confidence they have reposed in me. Considering the achievements of the Past-Presidents some of whom are gracing this occasion today. I am aware that the task before me will not be easy. All the same, I pledge to you that I shall spare no efforts to perform it to the best of my ability and given the spirit with which you elected me to this high office, I am confident that the Institution shall continue to progress in the years to come.

It is customary for the incoming President of the institution to address the Convention on some important aspects of engineering in its largest and widest context. In fulfilment of this, I now propose to speak three important aspects that are engaging the attention of engineers throughout the country.

IMAGE OF ENGINEERS

The first point engaging the minds of engineers is the question of their image, their ability to influence engineering activity and decision-making in the country, and the recognition of their services. There is a feeling that engineers have made—and are making—a great contribution to the nation but not recognized; that the engineers are not adequately involved in decision-making at high levels; and they are not happy and feel that they do not occupy the honoured place which they deserve the society.

The very concept of an image implies an object (namely, the engineers themselves) and a reflecting surface (which in this case is the public including statemen, politicians, administrators and above all the masses who comprise our great nation).

I will first express a few thoughts which deserve the attention of the engineers themselves and which could help enhance the quality, greatness and basic perforce of engineers.

Science and technology are making progress at a tremendous pace. More progress has taken place perhaps in the last 75 years than in the entire span of man's history. This pace will increase in the future Engineers must therefore keep abreast of the growth of modern science and technology; must learn to understand and apply new developments; and must have futuristic outlook and a long term vision.

Interdisciplinary Aspects

The interdisciplinary aspect of engineering will gain momentum. The importance of 'total outlook' has to be grasped by all of us. By 'total outlook' I imply that the engineering activity must comprehend and cater for all aspects of engineering problems, help a balanced growth of the nation, and reduce conflicts and problems created by incomplete engineering. Only one or two examples will suffice to show how the lack of a total outlook has created tremendous problems. Take for example the problems of population growth unaccompanied by parallel growth of agriculture (which involves major engineering in the form of irrigation, power, grain storage, fertilizers, tractors, pumps and so on); housing and transportation; pollution created by industrialization; and over-crowding and poor quality of life caused by unbalanced growth of cities (due to failure in developing employment opportunities and civic facilities in rural areas).

Engineers must appreciate the importance of the microscopic and macroscopic aspects of engineering. They must realize that successful engineering consists of investigation, design, execution, operation and maintenance, finance, planning for replacement of facilities, and a chain reaction on other engineering activities and on social and community life. All these factors must be visualized and engineering tasks planned and executed with balance, in harmony and in a coordinated manner. When all this is to be done at a minimum cost, within the shortest possible time, the responsibility of engineers obviously becomes a staggering challenge. There is no doubt that implementation of projects and their subsequent operation with efficiency and economy are major engineering responsibilities.

To ensure this, we have to concentrate on interdisciplinary work, give engineers the right education and orientation in interrelated disciplines and help them to develop skills both in the microscopic and macroscopic aspects of engineering. Shouldering Responsibilities A few other points requiring attention which will improve the engineer's image are:

(a) They must propagate, endorse and observe the Code of Ethics' promulgated by the Institution. To whatever engineering discipline we may belong, we must develop unity amongst ourselves;

(b) We must strengthen the activities and standard of the Institution as a learned society;

(c) The standards of project investigation and costing must be improved. The gap between the estimated and actual costs must. be reduced. Of course, much of the trouble arises from inadequate investigations as well as from investigations not done according to a long term plan; (d) In all engineering projects, control over quality and cost should be improved; .

(e) Operation of engineering projects must be carried out to a much higher standard of efficiency than at present; and

(f) In our deliberations and work, we must concentrate on giving the best and most effective service to the nation. First things must come first.

ADMINISTRATIVE REFORMS

I would now like to say a few words about some vital areas which affect the image and effectiveness of engineers but are not under their control and where reforms are long overdue:

(i) The management of most of the organizations and departments in the Government suffers from a divorce of authority from responsibility and from a peripheral association of engineers in the decision-making processes. I propose to elaborate on it in the next part of my address.

(ii) There are a number of impediments and irritants which hamper engineers' work and tend to demoralise them; for example, the ACRs of engineers in most States are written by administrative 'officers far junior to them in age and service; and the pay scales of engineers are low. I must particularly mention that the pay of our subordinate cadres, which are composed of fully qualified engineers, is meagre and unsatisfactory and does not bear proper relation to the responsibilities vested in them; the staffing pattern or the cadre structure in most of the engineering organizations is poor and affords very little opportunities to engineers for advancement; maintenance scales never keep up with the rise in costs and the increase in the expectations and standard of living of the public, which is resulting in an impression that engineers are inefficient and unable to maintain public services. There are a number of disciplinary cases against engineers which drag on for years and do not seem to take into account the circumstances prevalent at the time and do not attempt to distinguish minor lapses from major ones. The mere delay in dispensation of justice tends to become a denial of it. Stagnation in the subordinate cadres is alarming. Let me take the example of the Military Engineering Service only. The number of senior subordinates who are fully qualified engineers and are stagnating at the top of their scales for several years is approximately 1100. The introduction of the Indian Service of Engineers, which was a very progressive measure, was announced by the Government but the decision was later withdrawn. Implementation of the Administrative Reforms Commission's recommendations pertaining to the Engineering Services has been long overdue.

ENGINEERS' ROLE IN PLANNING AND MANAGEMENT

A basic fact that must be recognized is that our country is one of the largest but one of the poorest countries in the world. It has a rich heritage and unlimited potential. We are pledged to create a socialistic state based on social and economic justice. While progress in this direction has been made, the achievements are by no means adequate. We are faced with the task of improving the living standards of a large population which is estimated to reach the figure of 960 million by 2000 AD. Progress has to be achieved keeping in mind that the country will continue to face many threats to its security, and a sizeable expenditure on the defence of the country will continue to be incurred. The demands which the future will make upon us, will be far heavier and more complex than what we have ever faced in the past. The principal instrument available to the Lok Sabha and the Cabinet to implement their policies and to achieve the targets is the pub lie services. Today an impartial look at the administration of the country will show that it is neither sufficiently efficient, nor progressive, and does not enjoy the full confidence of the public.

I maintain that the basic weaknesses which have to be tackled are as follows:

(a) Recruitment, training and development of public administrators are unscientific and geared to an imperialistic state as distinct from a state wedded to achieve high standards of economic growth and social welfare.

(b) The entire administration has the character of a non-professional organization despite the fact that management has become a highly skilled technique and complex activity.

(c) There is widespread divorce of authority from responsibility,

(d) An effective system of rewards for good performance and punishment for its absence is lacking.

Regarding recruitment, training and development, the whole system needs to be nationalized. Our present system of examinations has little relevance to the tasks which have to be performed in public service. After the initial training, there is practically no organized attempt except in the Armed Forces, to train and develop officers. This function is largely left to learning by example and a sort of apprenticeship to the superiors. The development skills remains narrow. The narrow experience and the consequent narrow outlook is further made worse by an entirely vertical hierarchy in all departments. It is also developing interdepartmental jealousies and tensions rather than promoting an atmosphere of team work.

The character of management of public service is largely 'non-professional'. The result is that leaving aside a few exceptional men the performance of the majority of individuals concerned remains average. The low standards of achievement are also the result of the lack of a scientific and technical background the absence of organized training. It has to be recognized that it is impossible for any society to produce 'super-men' or 'genius' by the thousands.

The divorce of responsibility from authority and an atmosphere of non-responsibility are other fundamental weaknesses. It can be seen in most departments that the authority is almost exclusively in the hands of the ministerial officials and the responsibility almost exclusively rests with the departmental officers and the heads of the department. This is all the more apparent and all the more harmful in departments dealing with science, technology and engineering.

The problem of rewards for performance and punishment for lack of it remains largely unattended. Promorions and selections are still largely based on seniority and out of turn promotions are rare exceptions.

(a) In recruitment, training and development, an increasing role of science and technology and professional skills of management has to be recognized;

(b)In the actual development of administrators, a greater mobility is required not only from the bottom upwards but also laterally; and

(c)The administrators must have a varied background and experience.

The need for professional management is inescapable, and this has to become increasingly science and technology oriented. At the senior levels, there is need to increase specialization based on broad areas already recoganized by the Administrative Reforms Commission.

The system must develop and promote team work the rather than inter-departmental tension and hostility; Areas of specialization in administration recommended the Administrative Reforms Commission must be accepted and form the basis of training, development and progress of administrators. These areas are economic ministration, industrial administration, agriculture and rural development administration, social and educational administration, personnel administration, financial administration, defence and internal security administration.

The Administrative Reforms Commission has recommended that selections to these areas of specialization should be made from all Class I services based on merit and that the cadre systems should largely operate up to the level of Deputy Secretary/Director for the first 12 to 15 years of service, and thereafter selections to higher posts should be thrown open to other departments and also to professional men with record of proven performance not in Government service.

ECONOMY IN ENGINEERING

The magnitude of construction activities is increasing at a fantastic pace. Shri V G Rajadhyaksha, Member, Planning Commission, stated in September 1977 that construction activity of one kind or another — whether it is building roads or bridges, dams or canals, railway lines, airports or docks, houses or offices, factories or warehouses — is expected to account for over 40% of nation's developmental outlay in the Fifth Plan and will exceed Rs 24000 crores. It will account for even more in the Sixth Plan with the emphasis shifting to irrigation, housing and roads. All this excludes the very considerable sums of non-Plan expenditure on maintenance, re-construction and major repairs.

It is, therefore, dear that efficiency in planning, design and execution will play a major part not only in the successful implementation of these Plans but also lead to tremendous savings. For example, a mere 5% saving on Rs 24000 crores will be Rs 1200 crores. The word construction here includes all disciplines of engineering. It is clearly the duty of engineers to ensure that all projects are, in the first instance, investigated in complete detail. This requires time, expenditure and above all a long term plan. The Government must have a separate programme of 'Project Investigation' on a 15 to 20-year basis and accept the possibility that a small percentage of the projects subjected to investigation will not materialize, thereby leading to a loss of a few crores of rupees over a period of 15 to 20 years. The saving is likely to be of the order of few thousand crores. Engineers, of course, must make sure that the investigations are based on the latest available techniques. The next stage is design which is vital. It can be stated confidently that in the area of design lies the field for maximum economy. Economics achieved here cannot be matched elsewhere. Equally, errors made at the design stage are practically impossible to rectify later. Engineers must carry out the design in a detailed and competent way using the latest developments in all the relevant disciplines, and maintain clear and detailed records of the parameters, ground data and the calculations for satisfactory execution and also as an instrument of education to the younger engineers. They must avoid the waste inherent in outmoded theories of design or in a fear complex leading to over-design. I must also briefly mention here the importance of standardization and interchangeability and of selection of correct materials.

Modern techniques of planning and programming should be applied to all projects in order that they can be carried out in the shortest possible span of time, with maximum activities going on simultaneously and the critical path being clearly understood, although we must not forget that in a large project the critical path itself needs review from time to time. After this comes economy which has to be achieved by efficient execution of work and a vigilent control over the expenditure on materials and utilization of plant and skilled labour, all of which are becoming increasingly costlier. While doing all this we have to bear in mind that the structures, factories, warehouses and facilities created by us are capable of operation and maintenance at minimum cost.

As a lot of work is being executed in our country through the agency of contractors, it is relevant for me to quote a discussion held many years ago with Mr W X Mascarenhas, an eminent Chief Engineer of Bombay, who related some of the causes which add to inefficiency and high cost thus:

(a) Plans and estimates are rarely prepared in complete detail;

(b) Unrealistic provision for specifications for many items without taking into consideration the conditions prevailing in the particular situations and regions;

(c) Prevalent rules of acceptance of lowest tender, whatever be the rate;

(d) Delays in payment of running account bills;

(e) Idle capital in the form of earnest money and security deposits; and

(f) One-sided nature of the contract agreement.

I like to mention an interesting example of how we proceed with progressive measures. Realizing that the nature of the contract has a big influence on the cost of work done, the Planning Commission appointed a National Committee under the chairmanship of Maj-Gen Harkirat Singh, who is an eminent engineer, a distinguished Past President of the Institution and one of the ablest Engineers-in-Chief of the Indian Army. The aim of the Committee was to prepare a national draft of a contract form in consulation with eminent engineers in Government circles and in industry, architects, surveyors and experts in finance and law, chosen both from the ministries and the public. This Committee submitted a vital report recommending major reforms of the entire system about 10 years ago. It was only some three months ago that the file was sent back to me with 60 pages of comments by the Ministries of Law and Finance.

CONCLUSION

In closing, I like to thank once again the engineering fraternity for the confidence they have reposed in me and to assure them that I will do all I can to be worthy of their confidence.

I have placed before you a number of ideas and suggestions which may be followed by engineers in brightening their image and increasing their basic qualities and the ability to serve the nation. I have outlined a number of reforms which require attention on the part of the Government to enable engineers fulfil the vital task which are their responsibility and which only they can perform. My plea is not motivated by scramble for power. It is a plea for removal of impediments and for ensuring requisite support of progressive and collective machinery for decision-making and implementation without which no plan of large magnitude can succeed. I have briefly outlined to my brother engineers the vital role that investigation, planning and design and execution play in the case of engineering projects in the context of the tremendous investments that are being made on national developments. I hope to work for the implementation of the ideas I have outlined with your cooperation and blessings. I pray to God to give me the strength to do so.

JAI HIND

Presidential Address

(1979-80)

Appropriate Technology for Development of India

YOUR EXCELLENCY SHRI B D JATII, HONOURED GUESTS, LADIES AND GENTLEMEN,

First of all, I wish to express my grateful thanks to the distinguished engineering fraternity which has done me the honour of re-electing me as the President of the Institution of Engineers (India) for the Session 1979-80. I wish to assure them again that it will be my endeavour to prove worthy of this honour and of the confidence that they have reposed in me.

There is no gain saying that in nearly three decades of planned development India has made impressive strides. Compared to the base of the First Five-Year Plan, food production has more than doubled, industrial production has quadrupled and power generation has gone up many-fold. The roads and communication network has spread far and wide. There has been an overall leap in the GNP and the growth of the national economy as a whole. Simultaneously, a sound base has been created for science and technology. Despite these gains, the fruits of progress have not percolated to the poorest sections of the community.

Our country remains a land of contrasts. We are in bullock cart age; at the same time we have also a jetset society. We have skilled craftsmen on the one hand and, on the other, we have scientists and technologists of the highest order.

Next to the USA and the USSR, India has the third largest number of trained technical personnel and it ranks among the first ten major industrialized nations of the world. The number of qualified scientific and technical personnel has increased from 188000 in 1950 to over 1300000 at the end of 1974. This represents a sevenfold increase during the last 25 years. But if GNP is taken as a measure of development, India ranks quite low in comparison to a number of countries. At the same time it is a unique country. Its richness of thought, philosophy, heritage and unlimited potential — richly endowed by nature with such resources as fertile land, water, metals and minerals, bright sunshine and, above all, large mass of human resources in our villages, who are intelligent, resourceful and hard-working. The country presents a spectacle of plenty and yet at the same time heart-breaking scarcity.

We are pledged to create a socialistic state based on social and economic justice to all. While some progress in this direction has been made, the achievements are by no means adequate as we have not been able to meet the basic necessities and the expectations of the common man. The demands which the future will make upon the engineering fraternity will be far heavier and more complex than what we have ever faced in the past as we still remain a curious mixture of old and new, traditional and modern, rural and urban; obscurantism and science, handicraft and technology.

While liberal education should be provided to every one to understand his place in society and develop harmonious relationship with his neighbourhood, technological education must aim at developing skills, harnessing material resources for social prosperity of the common man by increasing his efficiency and effectiveness, the educational system should have application-oriented programmes, with particular emphasis on food, shelter, clothing, health, agricultural systems including flood control, local resources and materials, energy, communication, industries including agro and management, to facilitate major contribution to rural and community development, and should promote appropriate technology to handicraft and small industries.

An expert study has shown that the broad picture of India in 2000 AD will be:

(a) the population of India will nearly double itself;

(b) every year 5.4 million houses will have to be built;

(c) 274 million tonnes of foodgrains per year will be required against current year's record production of 125 million tonnes;

(d) 183 million tonnes of cement per year will be required against the current production of 19.28 million tonnes;

(e) 200 million tonnes of petrol per year will be required against the current consumption of 28/30 million tonnes;

(f) water will become the most scarce resource; and

(g) the labour force will go up by 238 million.

Thus there will be shortage of almost every consumer commodity—food, water, power, space, housing, etc—leading to a tremendous gap between supply and demand.

Forecasting the rate of technological change has been much beyond the reach of imagination. Then, it is. not easy to choose the future. It is all the more difficult to predict it. The economic challenge before a second India will, therefore, be to find the right priorities, the right projects, the right policies; and the right technologies. The task lies really in identifying what this right is and how right is right. According to Peter F Drucker, 'the very task is not to find the right way of doing a thing but of finding the right thing to do.'

The strength of a chain depends upon its weakest link. Likewise, the prosperity of a country is judged by the welfare of its economically weaker section. Then one of the biggest resources of the country is the human resource. The challenge of 960 million people in 2000 AD is not merely a challenge to scientists and technologists, it is also a challenge to political leadership. Our effort should be to turn the large mass of 920 million people into a resource, into an asset. We have to do everything conceivable to mobilise this mass of humanity. If it is organized on proper lines and given the wherewithal, our rural human force can be turned into an asset.

On the part of political leaders, this is going to call upon political wisdom and management of the highest quality. We, the engineering fraternity, must contribute our share for the well-being and in meeting the basic necessities, for which we must start preparing ourselves for 2000 AD from today, otherwise it will be too late. This involves the choice of right education and of the right technologies.

As the Institution has organized a three-day National Seminar on 'Educating the Engineer of the Future' in continuation of the 59th Annual Convention and eminent experts are going to deliberate in detail for full three days, I should not say more on the education and training of engineers. I will mainly deal with the choice of appropriate technologies for development of our country.

INTRODUCTION

In ancient times, the technologies in all countries were based mainly on traditional skills passed down from generation to generation. Different countries have developed their technologies on the basis of locally available materials and skills in response to their immediate needs.

The countries, which were the direct beneficiaries of the industrial revolution of the eighteenth century, advanced rapidly-while those countries which were not affected directly by it remained more or less stagnant, thus creating a developmental gap between the two groups. This gap continued to widen with the passage of time. It was believed that this development gap could be narrowed by the transfer of science and appropriate technology. Experiments carried out to check this belief proved successful and a number of countries such as Hong Kong, Japan and South Korea were able to advance very rapidly by importing appropriate technology from developed countries.

However, those countries which had depended mainly on imported technology for development soon came up against numerous difficulties as several large-scale industrial enterprises based solely on imported technology resulted in failures or near failures. In the mid 1970s, during the world energy crisis, difficulty in securing industrial raw materials and food imposed a considerable shock on the economy of South Korea, which was heavily dependent on imported technology. Investigations into the causes of such failure revealed that unless the developing countries built up their own internal systems and institutions to absorb science and technology based on their strength and weaknesses, they would not be in a position to effectively utilize imported technology.

In addition, imported technologies which were mostly capital intensive, labour saving, urban oriented and which were based on high levels of energy consumption and thus incompatible with the urgent emphasis on employment generation as development objective, tended to create imbalances and social tensions by replacing traditional skills, and widening the urban rural gap.

Appropriate technology includes not only economic viability and technical soundness but also adaption of a technology to the social, cultural environment and other local situations of the importing country. This concept of development has necessitated a strong emphasis on adaption of appropriate technology. But what is the appropriate technology? Appropriate technology is not an absolute concept. The term 'appropriate technology' may be defined as 'the technology that contributes most to the economic, social, and environmental objectives of development goals, resource endowments and the economic and social environments in which it is to be applied'. It is also a dynamic concept that means a set of suitable technologies might need to be developed and changed in a given set of circumstances over a period of time in response to changing conditions.

SELECTION OF APPROPRIATE TECHNOLOGY

Conditions vary from country to country, and each country must select technology appropriate to its needs in the light of not only its traditions and culture but also of contemporary conditions. A technology which is appropriate for one country may well be the wrong choice for another country. Not only this, a technology which was appropriate yesterday may not be appropriate today.

What is required is a technology which is more productive than the indigenous and, at the same time, cheaper and easily manageable, and is capable of creating more work where the masses live; if possible, at the doorsteps of the rural poor.

The criteria for selection of appropriate technology must be based on harnessing the potentialities of the entire spectrum of sectors from cottage to the large scale sector. Selection of technology must be based not only on considerations of engineering but also on the philosophy accompanying it. Because of this, the problem of laying down a criterion for selection of appropriate technology is very complex. However, a few of the general principles which should guide the selection of technology for India are:

(a) It should be labour-intensive and should generate more employment. It should supplement the labour, not supplant the labour;

(b) It should concentrate on areas which serve the basic needs of the population such as food, housing, clothing, energy, highways, public transport and social services;

(c) It should increase productivity and generate a surplus;

(d) It should reduce the urban-rural imbalance;

(e) It should not require large quantities of vital and scarce resources;

(f) It should be simple and capable of successful implementation without creating major problems of labour training;

(g) It should provide employment to the masses where they live rather than increasing the influx into urban areas; and

(h) It should exploit strong points and avoid weaknesses.

Migration of the most productive sector of our rural population to the more lucrative urban areas has brought about a severe shortage of much needed entrepreneurs and skilled workers in our villages. This has led to widening of a development gap between the urban and the rural sectors which, if allowed to continue, would unleash disruptive forces from within. A policy of decentralization or dispersal and moving away from urbanization, conglomeration and concentration is a must to resolve the problem of poverty and unemployment. Then social stability criteria make it necessary to adopt technology which would also moderate the dualistic nature of the industrial and the agricultural sector in which the former is modern and dynamic while the latter is traditional and static.

Rural industrialization throws up special challenges in technology to use locally available skills and raw materials due to inadequate infrastructure in our rural areas. It calls for a detailed examination of the technological needs, capabilities and attitudes of rural population. Employment creation is not a goal in itself, the goal should be to create productive and efficient employment. It should be productive and efficient so as to add to national outputs and not merely redistribute it. In being efficient it should make an optimum contribution which, in any case, should be in excess of the wages paid. 'Economic Plan' and 'Technological Plan' must be closely integrated with each other. Then it should be economically, socially and technically competitive with other types of modern technologies in order to survive.

The application of appropriate technology would, in some areas like power, steel, basic chemicals, necessitate the use of modern and sophisticated technology and processes but greater emphasis is needed to be given to the application and development of small scale, low cost and simple technologies which could be utilized to a greater extent for the direct benefit of the masses.

The identification of needs, the formulation of objectives, and the determination of the appropriate strategy of development involves not only economic and social but also political judgements, and these are essentially for the government to make. The strategy having thus been determined, the question of appropriate industries to be developed has to be determined. It is only thereafter that the choice of industrial technologies can be considered. This will involve taking many factors into account, viz, the size of potential market; the optimal exploitation of local natural resources; available option as to the scale of production; the desirability of geographical dispersal ; technical efficiency in terms of material and energy consumption, availability of trained man power, etc. No technology is in itself either appropriate or inappropriate. It becomes appropriate through an exercise of choice based on defined strategies for development encompassing the set of national ends.

CLIMATE, MECHANISM AND AGENTS FOR DEVELOPMENT AND TRANSFER

The plan of action to be adopted by India for application of science and technology to national development -should not only correctly reflect socio-economic needs .and goals but should also give serious attention to the measures for development and transfer of technologies. A culture in which people think spontaneously of scientific research as a way of solving problems is a necessary medium for the growth of the entrepreneurial attitude. Technological temper and attitude will then become a way of life of the people, increasing their ability to ask for, absorb, assimilate, innovate and utilize technology and create a thirst for new and more technology . For such a plan of action to be carried out effectively, there are certain conditions which we must create in order to provide a favourable climate for both development and transfer of technologies.

We are in the process of implementing an industrial and economic policy for solving the problems in agriculture and industry. The Government is rightly stressing the need of relating, relevant, immediate and appropriate technology which increase the employment potential. Advancement in science and technology requires the setting up of a vast infra-structure including higher education and research and development institutions. Whatever superior technology may be introduced from abroad, the essential thing is that it must diffuse and take root in the country in order to he of real use. This can be possible only with integrated network of institutional and research framework at international, regional and national levels to accelerate indigenous development and transfer of appropriate technology with emphasis on self-reliance and cooperation. The greater the capacity of the nation to generate, acquire, adapt, innovate, transfer and utilize appropriate technology, the faster is its growth and faster the development.

An essential and important component of the infrastructure is the research and development efforts and in this regard special attention needs to be drawn to our past experience, Tn the first decade of development scientific and industrial research was loosely structured, with no specific national objective in view. Programmes followed individual expertise of the scientists who had little contact with or exposure to industry or Government planning. The technologies claimed to have been developed were successes on laboratory bench scale. The much greater expenditure of engineering effort and the painstaking debugging in a pilot plant was largely absent. As such, the national laboratory technology could not be easily transferred. Part of the fault was of the scientists. They undertook advanced research similar to that in the laboratories of the advanced countries. Anxious to publish results abroad, the problems undertaken lacked relevance to the 'mundane but real' needs of our country. A major effort had to be made to cultivate amongst the scientific community the acceptance that in a poor country with enormous problems, the social responsibility of the scientists demands a determination of the individuals to direct their professional and technical efforts primarily and dominantly to resolve the actual sophisticated or unsophisticated problems connected with national goals. There has since been a qualitative change of commitment of individuals and institutions. The transfer of technology from laboratories to the industry has greatly improved, especially when in many cases even design engineering consultancy firms are involved right from the pilot plant stage onwards. This has helped to reduce the time lag between the development of technology in the laboratory and its transfer to the shop floor thus enabling the benefits of technological research to be transmitted quickly to the society.

Creation of basic infra-structure in the villages and provision of skills which are not locally available, will increase the productivity of the rural sector. Traditional skills will thus be linked and linkages established with modern technology improve productivity and ensure quality. In order to provide the basic infra-structure to the villages, the need for building development centres which deliver rural goods and service to urban markets and vice versa, is being now increasingly recognized by the planners.

The strategy of self-reliance can only be pursued if the output from the technology generating institution is matched with the identified needs and there is a commitment of the society to favour utilization of domestic, natural, industrial and human resources even if this involves some short-term disadvantages. Social attitudes have to be moulded to promote enterprises based on indigenous technology.

The situation also demands considerable emphasis on working with social scientists and others in tackling human problems of our large mass which may entail changes in the value system. Indian technology will have to adopt this as philosophy for the future plan of action if it has to serve the masses and the rural areas in particular; which engineers as a fraternity have to do, to serve the needs of the nation. We should be aware that even the slightest lack of harmony and co-ordination between social scientists, the scientific base and technology or between theoretical knowledge and engineering practice or between motivational requirements and condition of employment or between technology development and national aspirations or between engineering leadership and administrative leadership or between categories of engineering personnel, leads to loss of precious talent and time, misuse of resources and to frustrations and tensions in the society.

Most of the problems in technology transfer arise out of the overwhelming bargaining strength of suppliers of technology. The recipient is made to suffer several restrictive conditions imposed by the suppliers as well as political pressures. The conditions include export restriction, demand for exclusive privileges regarding local resources, tied purchases of intermediate products and raw materials, secrecy clauses regarding use and dissemination of know-how, etc. Many of these restrictive practices are prohibited by legislation, but they are still practised by a few multinational corporations. These restrictions limit the scope for national development, possibility of regional co-operation and benefits which may be derived from introduction of generalised scheme of preferences

MOBILIZATION OF SCIENCE AND ENGINEERING

The problem of insufficient flow of technological information is also due to inadequate growth of information industries. The information industries comprise the broad areas of activities ranging from the 'knowledge industry' (such as education, research and development), the information distribution industry (such as publishing, mass communication and telecommunication) and the manufacturing industry of machinery and equipment for communication and information. The growth of information industries is hampered by the small size of the market for information and the low value placed on it. While no one denies that the industralized countries and the international agencies could be more effective in stimulating the diffusion of technology, at the same time there is a growing realization that the greater part of man's technological know-how is already freely available and the biggest problem is to evaluate and apply it.

The success of any venture to promote the transfer of technologies to India depends upon the co-operation of enterprises in the advanced countries. The problem is to find a mechanism which will meet the interests of these enterprises as well as our interests. This brings us to the concept of technology transfer agents. Apart from being an instrument for industrial and economic growth, technology is also a commodity. It has a cost, a life-cycle a long gestation period and is transferable and marketable. Sales and transfer take place in an imperfect market and the price is negotiable. The role of technology transfer agents is presently being played by public research. institutes, universities, government institutions, embassies, trade missions, banks, consultants, private business associations and private R & D establishments. However, in view of the growing complexities, involved in the transfer of technology, it is now essential to strengthen the national, intra-national and international organizational arrangements, viz, National Centre of Technology Transfer, Regional Centre of Technology Transfer, and International Centre of Technology Transfer under the auspices of the United Nations. The establishment of 'Regional Centre for Technology Transfer' at Bangalore in 1977 is a significant landmark in promoting the technology transfer.

SUMMING UP

Rapid socio-economic development of India calls for identification of the people's needs and implementation of a science and technology plan which should clearly spell out the goals to be achieved. The fast growing, number of available technologies requires to lay down a criterion for selection of technologies appropriate to its contemporary social, economic and cultural conditions. Stress must be laid on development and upgrading of traditional skills and technologies. Imported technologies must be modified, adapted and developed so that they are absorbed in the country and, in time, become indigenous technologies. An integrated network of institutional framework at national, regional and international levels is required to accelerate indigenous development and transfer of technology. Concepts as self-reliance and co-operation are no more mere slogans. They can be made to work.

Then if we have to meet the tremendous challenges in front of us, ie, second India, not only we have to train and prepare ourselves from today, not only to select the appropriate technologies to meet the basic necessities and aspirations of the common man but also to forge the instrument through which we have to implement this goal and this instrument has to be the administrative machinery of India. While a lot of wise and mature political direction is available to the nation, in the administrative machinery, there is a state of perpetual conflict between the administrative services, the finance and the engineers. A cool, dispassionate and deep look at the task will point that the physical activities will and should lie predominantly with engineers. If the state of conflict is allowed to continue then the efficiency will be low. This matter has been deeply gone into by experts including the Administrative Reforms Commission, headed by our distinguished Prime Minister. The actual action taken on sum total on Expert Commission report is almost negligible. It is, therefore, my earnest plea that ways and means must be found out at national level to remove all the impediments and conflicts from the administrative machinery, so that we as engineers can deliver the goods and make the 21st century an era of plenty and not of scarcity.

JAI HIND

Lt Gen J S Bawa — a Brief Profile

A good and kindly gentleman — exemplifying what many parents hope their sons would be: strong and courageous and honest and compassionate-whose true greatness and triumph lies in his moral forces; a product of disciplined army life and of its ideals, driven by a compulsion to do the right and do it well; a man of deep faith in the greatness of God and in the goodness of people, and for whom words like 'work' and 'action' are not mere cliches but are living truths. His is an unforgettable voice that rolls majestically, convincingly and persuasively with an unfailing sense of humour. At one time or the other, we have all been enveloped by his charisma. The core of that quality — an innate interest in other people that is always in evidence in his soft-spoken cheery words, sociable spirit and ever present sense of understanding. This is Lt-Gen Bawa, Engineer-in-Chief, Indian Army, who is our new President for the Session 1978-79.

A man of generous disposition, immense force of mind, lofty principles and ideals — a quick learner and a fast doer with boundless energy, unrelenting commitment and unsurpassed dedication — he has not only captured the trust, faith and affection of army men but has kept them vibrantly alive, co inspire them, to cheer them, to bring the best in them, and to give them a lift. As the years have passed by, his stature has grown with this task.

After obtaining his first degree from the Punjab University, Lahore, Gen Bawa was commissioned to the Army in 1940. He received his further education at the Indian Military Academy, Dehra Dun and the College of Military Engineering, and later proceeded to the Royal School of Military Engineering, UK, for extensive technical and military training.

Gen Bawa has held various assignments in the Corps of Engineers of which he is the Head. He holds the responsibility for two main functions, firstly, Combat Engineering Support to the Army and secondly, construction, maintenance and operation of civil engineering requirements and electrical and mechanical services for the Army, Navy and Air Force, Ordnance Factories and Defence R & D Organizations. He is also the Head of the Military Engineering Services which by all estimates is the largest construction agency in the country and is responsible for the latter of the above functions.

His 37-year long military career has brimmed over with dedicated service and magnificient engineering achievements in the field of engineering. He remains inseparable from the greatness of his organization in the building of which he has mightily shared his precious knowledge experience an energy. As an engineer for a vitally important assignment, his dynamic leadership has helped to keep steel in the organization's backbone and the flame of fame in its soul.

During all this period, being in executive charge of a great variety of construction works involving several crores of rupees, notwithstanding exacting conditions and hostile environments, Gen Bawa contributed extensively to many new developments and major expansions- to a whole gamut of construction activities which by their very nature call for mature skills in many areas, namely, technology, administration, finance, contracts and negotiations, and last but not the least, personal relations and resources management.

In his combat engineering and construction assignments, In his capacity as the Commander of a Regiment, the Chief Engineer of a Corps and the Chief Engineer of the Western Army Command, he has to his credit many major works and prestigious projects (for the Navy and Air Force) for which he has given a large share of his talent and expertise, to cite a few, these include many buildings, bridges and roads, water supply and power schemes, demolitions involved in bridging rivers, the Jyoty Project which involved the construction of a large military township and housing colony at Ferozepur completed in a record time, major construction projects at Jammu, Udhampur and Srinagar airfields, planning of Chandigarh cantonment, and important constructions in the Punjab, Jammu and Kashmir and Delhi regions. An outstanding engineering administrator and planner, Gen Bawa has also rendered invaluable service for over seven years in the Border Roads Organization where he has successively held the posts of Director of Logistics and Chief of Equipment Division; Director of Technical Planning and later Director-General. Exercising great ingenuity and leadership in managing a work-force of more than 50000 technical personnel and over 1000 officers and the largest fleet of tractors, compressors, heavy vehicles and many other construction equipment In the whole of Asia, he achieved outstanding results in highway construction and bridge building in perhaps the most difficult hilly terrain in the world and along the borders of India from Rajasthan to Mizoram and Nicobar Island.

All in all, his engineering assignments in the army have thus spawned an era of enormous change in its life. He has played a vital part In that change; and the devoted leadership he has given to that *cause has In turn brought In extra element of grace, elegance and courtliness to the professional 'Engineer'.*

Notwithstanding his vigorous role as a soldier and an engineer and the rigours of field work day In and day out, Gen Bawa has found time to devote himself also to the cause of education. He has served as Senior Instructor at the Defence Services Staff College, Wellington; and as Professor of Civil Engineering and as Dean of Instructions In the College of Military Engineering, Pune.

Apart from his military engineering tasks, Gen Bawa was selected by the Government of India for another exalted position In the Public Sector, namely, as the Managing Director of Burn & Co and the Indian Standard Wagon Co during 1974. The remarkable improvements he brought about in rehabilitating these sick units and the leadership he gave in that context are too very well known to recount here. In 1975, promoted to the rank of Lieutenant-General, he was called back to take up the high office of Engineer-in-Chlef in which post he now serves the nation.

His engineering and defence service involvements, however, have not reduced the General's tempo of activities In other spheres. He has represented India in several International Highway Engineering Conferences In Canada (1970), London (1971) and Czechoslovakia (1972). In 1973, he was deputed to Guyana, South America, to render advice on a major re-organlzatlon of their highway engineering department.

In consequence of these accomplishments, honours and offices were there for him in abundance. He was decorated by the President of India twice with the Ati Vishisht Seva Medal (AVSM) for distinguished services of an exceptional order in 1962 and with the Param Vishisht Seva Medal (PVSM) for distinguished services of the most exceptional order (the highest decoration for distinguished services awarded to a soldier) in 1975.

His devoted association with the Institution, of which he Is a member for nearly 30 years, has been memorable. He has not only concerned himself with the affairs of the Institution but has been continuously contributing to its welfare and progress in many directions. He was Chairman of the Civil Engineering Division during 1976-77 and is presently Chairman of the Delhi State Centre of the Institution.

Having risen through literally all the membership grades which has given him a knowledge of the inherent defects and built-in advantages in tackling the Institution's problems, Gen Bawa has gained a multifaceted background which in turn has given him a pretty good feel for its strength and weaknesses. He is keen that the Institution should be more responsive to the needs of members and believes in positive actions rather than in pious decisions.

Unquestionably a man of many accomplishments, his interests in the Institution have ranged Widely. He is equally at home at the opening of an international conference as when he is debating on a technical issue at the Councilor on the acceptance of a paper for the journal. He is a believer in life-long education for engineers and has been invaluably contributing to the formation of the Institution's Engineering Staff College.

With the strong conviction that the Institution's participation at various levels can have a far-reaching impact, with unrestrained enthusiasm, he has been steering the conduct of many Important technical and professional committees, as Chairman in many instances. His contributions to professional engineering have been quite substantial; he has fostered its furtherance with conscientiousness and untiring energy.

Gen Bawa is associated with many other professional bodies outside the Institution also. He is a Fellow of the Institution of Civil Engineers, London; Member of the Indian Roads Congress; Member of the National Committee of the International Association of Bridge and Structural Engineering; Member of various Advisory Committees of the Council of Scientific and Industrial Research; and Member of the Indian National Society for Soli Mechanics and Foundation Engineering (now known as Indian Geotechnical Society).

The unanimous election of Gen Bawa as our President brings to us a dynamic leader and a selfless worker through whom the Institution and the engineering fraternity seek guidance, direction and lead. To help him fulfil his mission-consecrated to service-is the responsibility of each of us. Let us commit to continue to give him our best.

Gen Bawa will take over the office of the President of the Institution of Engineers (India) for the Session 1978-79 from the retiring President, Dr Amitabha Bhattacharyya, FIE, at the, 58th Annual Convention of the Institution to be held at Gauhati on January 14, 1978.

Shri S G Ramachandra
President 1980-81 & 1981-82

Presidential Address

(1980-81)

THE NATION'S DEVELOPMENT IN PERSPECTIVE — ENGINEERS' TASK NOW AND LATER

OUR DYNAMIC LEAD

I consider it a great honour that my colleagues in the Council of the Institution have unanimously elected me President of the Institution in succession to Lt-Gen J S Bawa for this momentous session which has auspiciously begun with the celebrations of the historic Diamond Jubilee of the Institution. I am deeply moved and humbled by this honour and I offer my fervent prayers to the Great Almighty that He gives me enough confidence and strength to guide the affairs of this National Body, thereby to further the contributions of the engineering fraternity and the profession to the continued development and prosperity of our great country.

A galaxy of eminent Presidents of this Institution have guided the development strategy of our country over the last 60 years in various official and non-official capacities. Three of them were members of the Central Government and in that position they greatly influenced the political thinking during their times. Many of the distinguished members of our profession are currently involved, in the planning process both at tlie State level and the Central level. A few of our colleagues are also placed in important positions, namely, as Secretaries to Technical Ministries at the Centre. Obviously, it is the leadership and dynamism of all these men in various offices and their contributions to the profession and the larger interests of the people that have enabled them to be the chosen few to occupy such important governmental positions. They have also been trying their best to inject the concept of decision making into the bureaucratic system. May be they have still not succeeded to the extent they desire, but it is doubtless that they have certainly been able to impress upon those concerned the fact that for guiding and energizing the technical ministries it is the technologists who make better decision makers than generalists. These worthy friends of ours can help the profession to build its image higher — to be sought more and more as a profession selflessly committed to serve the nation and its basic objectives.

MANY-SIDED PROGRESS

I would like to record that the development of our country during the last 60 years has been a period in which the nation did not spare any effort to build up its infrastructure at a rapid rate. The extraordinary progress and achievements we witnessed in our irrigation system, transportation system, communication system, education system, mining and manufacturing, energy developments, agricultural base and industrial enterprise — as a matter of fact any area in which engineering was involved — it is needless to say, have indeed been due to the combined will and steadfast efforts of all our people.

As the members of a profession as great as engineering — we are constantly at work planning, reviewing and revitalizing our actions in serving the people. The celebration of our Diamond Jubilee is, I consider, one such historic action. The Council fully aware of its complex and dynamic role in the upkeep of the profession and its responsibilities to the nation has consciously chosen for this occasion the theme "Engineering the Future for the Benefit of Mankind" to provide through its National Seminar a unique opportunity for introspection and review as a result of which we will have a chance to revitalize our own concepts of long range planning and sort out now to go about with it to enable the millions of our countrymen to achieve a desirable quality of life.

OUR INVOLVEMENT

Our profession has rigntfully claimed many positions in management. However, in order to understand our responsiblllties even better, it is essential that we should involve ourselves with the society more intimately, and understand its "needs and problems and also how technology leaves its impact on society. In an' analysis of the situation, Peter F Drucker wrote in 1968 as follows:

> 'The political matrix of social and economic life is changing fast. Today's society and policy are pluralistic, the reality that governs our behaviour is that of organized, indeed, over-organized power concentrations. Yet we are also approaching a turning point in this trend. There is rapid disenchantment with modern government as well as cynicism regarding its ability to perform. The young everywhere are indeed rejecting all institutions with equal hostility.'
>
> 'Knowledge, during the last few decades, has become the central capital, the cost centre, and the crucial resource of the economy. This raises the problems of the responsibilities of the new men of power, the men of knowledge.'

When I first read this statement 10 years ago, I thought that it had a western context. But after reading it repeatedly for the last few years, I must confess that it has profoundly influenced my own thoughts on the catalytic role that men of knowledge — the professionals and the men of power, namely, the administrators, can and should play in a country like ours. I have also been pondering on the question: what kind of technopolitical-administrative matrix should a developing country possessing an enormous reservoir of knowledge develop? I am sure many of you must be asking yourselves a similar question.

What inputs do we have for evolving a suitable matrix which would provide, over a reasonably long term basis, answers to many of our problems? The data base which our country has developed during these 60 years may not provide accurate models. But I am certain it is adequate to give us a perspective of our short term and medium term problems and at the same time, enable Us to evolve a long term planning strategy to achieve our goals.

THE AD 2000 PERSPECTIVE

It has taken us nearly 56 years to double our population to reach the 500 million mark now. It will take us only 35 years now to double our population again to a 1000 million (Fig 1). Official studies which have been undertaken to determine the trends in the shift of population from rural to urban areas give us an indication of the nature of the problems we may have to tackle in consequence of such shifts. Quite a few interesting studies on our urbanization trends and the problems of urban and metropolitan areas have been recentIy published (Fig 2 and Table 1). The impact of such population movement on housing water supply, sanitation, public health, transportation, education, communication and the related services can all be anticipated (Table 2). The resources required — skills, material and fiscal — can also be quantified. Projections in the case of a few vital sectors such as food fertilizers, mining and manufacturing, metals, etc are all available and I have discussed these cases in my Address to the Students Session during the last Annual Convention at Bangalore in February 1979.

If shortages in these vital sectors have to be avoided, we as profession, no matter where we serve — planning, decision making or execution — should organize and unify our efforts to make these goods available. We can no longer afford to think in terms of individual disciplines and rest content that some one else should initiate action. The area of work and the responsibility with which each one of us is concerned has a linkage with the overall supply and demand situation and therefore, as a duty, we should endeavour to keep the supply line ahead of demand. In other words, we should become more responsible and more productive than what we have been during all these 60 years.

OUR ENERGY SCENE

As a case in instance, I will deal with one aspect of our economy in which I am closely involved in my own special work field. Having specialized in electrical engineering, I chose to make a career in electrical manufacturing. In a way the business I am in is responsible for making energy available to the millions in a form which they can use for productive purposes. In this backqround, I have been continuously studying the growth trends. of our Energy Sector particularly since the Institution set up various working groups in specific areas under its Committee for Advancement of Technology and Engineering (CATE). "Power" has been my responsibility in this context and coupled with this, I am also closely associated with the work of the Indian National. Committee of the World Energy Conference the Secretariat for which is the Institution itself. In the course of my work in these committees, I have had the opportunity to gather a Jot of data and information — specially on our energy and power aspects — and I would very much like to share this collection with my professional colleagues today as I feel that our concern for the future of mankind in general will probably result in an action plan to help our own country sustain at least the present quality of life by the turn of this century.

To get into some details. Tables 3-6 show the trends of our energy consumption and availability in the past. Table 7 shows our energy supply and demand pattern and the perspective of consumption sector wise on the basis of some studies made by the government and other non-governmental agencies. Figs 3-5 and Tables 8-10 indicate similar studies fuelwise. For a moment, even if we consider that these projections are sheer academic exercises done by operations research specialists, they are still useful since they give projeetions of trends, and provide a framework for the purpose of planning and resources development.

As you will observe, a study of these figures gives rise to some fundamental issues and I propose to discuss them briefly now. Our coal production and availability have always lagged behind demand. Although we have recognized in all our policy documents that coal is a priority area, we have not at all been able to develop this industry adequately.

Similarly, our country's consumption pattern of petroleum has shown that the demand for naphtha, diesel oil and furnace oil have increased very steeply. Notwithstanding our official energy policy in favour of coal, we have had access to a form of energy which was easily available and we have continued to prefer that form of energy.

At one time, our investment on the development of the coal industry was considered inadequate, but an attempt was made to correct this in the Fifth Plan period. Even then, our economy has continued to suffer to this day; and obviously, it is the slippages in achieving physical targets in our vital energy sector that have been mainly responsible for this sufferance.

Looking at this failure one gets the doubt whether the country basically lacks an organization structure which will enable it to achieve the goals and targets. In the past, we have held many seminars and workshops on the subject of 'coal and electricity'. The exercises indeed proved valuable and in consonance, the recommendations that emerged out of these deliberations were also studied by those in authority who verily concurred with the views of the Institution. And yet, what we see is that the management structure of our system has not been able to get results.

I like to ask whether we need therefore a basic change in the system itself to shake us out of our complacency? As we have been witnessing, a highly centralized planning system for energy with a decentralized executive responsibility has only resulted in pockets of energy surplus and deficit zones: and the pressing need to streamline the financing of our related projects has been growing. I therefore suggest that the entire system of energy planning, project execution and financing should be reviewed again from the point of view of reducing the time scale from planning to energy availability. Further, the concept of accountability should also be firmly rooted in all those that are responsible. I feel the implementation of these suggestions would not be very difficult when seen in the light of the excellent results we have already, achieved in the case of some of our national projects both in. the public sector and the private sector.

As one connected with our electrical manufacturing industry during the last three decades, as mentioned earlier, I would like to reflect on the achievements in this sector. Although the industry has grown vertically in its dimension and has established for itself the image of a dynamic industry capable of manufacturing energy equipment not only for our country but also for others, it still needs to further improve its performance in terms of reliability of equipment. Apart from this, the industry must also find solutions to the problems it is beset with so that the delays in deliveries, erection and commissioning of plant and equipment as well as the operational problems can be minimized.

I must emphasize here that to build a competent indigenous capability all the professionals involved in this sector — R&D men, designers, manufacturing engineers, systems engineers and operations and maintenance engineers — should do all their best to identify the problem areas and evolve satisfactory solutions to make Indian equipment the most acceptable in terms of reliability.

Energywise the year 1979 has been a difficult year for us. Severely damaged by floods two years ago, our coal mines never got off to the desired production levels. Similarly, the petroleum sector also suffered due to shortaqes in availability; and at the same time increased our demand for petroleum products caused by non-availability of coal and electricity. In spite of new additions to installed capacity, our electricity system suffered in turn due to non-availability of coal and lower plant availability caused by continued failure of boilers and other associated equipment. The hydro systems has had the experience of the worst drought in recent years.

All these naturally led to an overall energy shortage, stretching the agriculture, transport, industry and mining and manufacturing sectors of our economy to the limit of endurance. I do hope that in spite of this, we can avoid a total structural failure by combining our wisdom and the will of the profession.

My discussion so far on the status of our energy resources naturally brings me to the area of energy conservation. In our process of growtb, we have always taken energy availability for granted. Experience has now brought the realization that we have no short term solutions to this problem except conservation. Price trends in the energy sector will force all consumers to evolve more efficient methods of energy utilization. To ensure countrywide involvement in this effort, the engineering profession, together with the active cooperation of the government, must give lead to a national programme for effective energy utilization. In pursuing this national programme, the area on which interest should be focused are:

(a) Changing consumer behaviour
(b) Elimination of wastage of energy
(c) Promotion of technical developments to save energy in all sectors
(d) Substitution of existing terms of energy by more appropriate forms
(e) Promotion of investigation of energy balances to define losses
(f) Introduction of national standards for energy consumption

Non-commercial energy is other area which needs our immediate attention. Our energy projections (to which I have made reference earlier) have been based on certain assumptions. Actions are very urgently needed to handle the tecnnological challenges and options in this area. The scenario's presented have confirmed the need for making our demand for non-commercial energy more or less constant at the current levels. It is equally necessary that we should regulate our consumption of renewable resources to the limit we can so that we could renew them. Let us see that options we have to achieve this objective. The bulk of energy is consumed in our rural areas for domestic cooking. This need is being met today by a process of self or the family collecting agricultural or animal waste. If we attempt to instal for this purpose a central system in a commercial form, it may not be acceptable to the society. Many of the new solutions suggested to reinforce our growing energy requirements — such as bio-gas, energy plantaions, solar energy, wind energy, etc — must have to be converted into innovative, viable commercial or cooperative systems if they are to be really beneficial to the community. This, however, involves many aspects related to governmental policy and administrative capability. Alternatively, each individual must have motivation to innovative and generate his own energy resources.

We have now reached a stage here we can no longer look at 'energy consumption per capita' as a sign of growth. On the other hand, the question is how we can maintain our growth rates with reduced energy consumption. A number of factors have been adding to our concern in this important area of development, and some of these are:

1. Failure to meet the energy demand for the baste needs of the economy will cause inflation and unemployment, and will consequently slowdown our growth rate;

2. Absence of long range planning will result in inadequate lead time for project planning and execution;

3. Our fuel options for electricity generation are getting narrowed down to nuclear option. So far, the lead time for executing our nuclear schemes in view of their technological and political complexities has been long and therefore, we should give serious thought to devise means for reducing the lead time;

4. The problems associated with better utilization of our coal reserves as primay fuel for power

generation must be solved with determination;

5. Planning for the energy sector should also include planning for transportation of energy as well as transportation of primary fuels;

6. Manpower development in the critical areas of the energy sector-such as exploration, investigation, project planning, resources development, and project management, operation and maintenance- has not received adequate attention to meet the needs of the next two decades;

7. Our choice of technologies have always been based on short term considerations. We have not made serious attempt to develop indigenous capabilities in design and development as a part of a long term growth plan.

After the last World War, we have been witnessing a continuing revolution in the fields of electronics and transportation. Similarly, I foresee a technological revolution as a fall-out of space research. A part of this, by way of miniaturization in electronics and power devices, is already gaining increasing use even In the present decade. I also hold the view that the energy crisis and the type of solutions which the engineering profession would offer to tackle the crisis would give rise to many new technologies, which have currently remained without proper identification for purposes of economic application. The lead time for adoption of these technologies into practical use would definitely be far less than the lead time we had in the past and hence my concern; and

8. Conservation and efficiency of energy utilization have in the past been neglected, and there is urgent need to develop. Competent teams of conservation and efficiency engineers.

SELF-HELP MOST ESSENTIAL

As a profession we should not depend on others to solve all these problems. Having so far looked outside the profession for policy guidance from political and administrative authorities, we have been silent spectators in the development scene. I would therefore strongly plead that the profession should do some serious introspection and come out into the open with technical and management leadership to tackle the problems which the country is facing today. This will need a large number of knowledgeable men with authority and responsibility. It is here, I feel that the statement of Peter Drucker which I have quoted earlier be- comes extraordinarily relevant to the conditions in India. I requote: 'knowledge has become" tne central capital-the cost centre-the crucial resource of the economy'.

Naturally, a professional body like ours with a multidisciplinary structure has a positive and responsive role to play in times like the one we are passing through. Our Institution provides an ideal organizational base for men of knowledge to make their impact felt on the society.

THE FUTURE AND IE(I)

For the next few years, the Institution's main objective should be to reflect the concern of the engineering profession on matters of economic development; and organize the professional men at the State Centre level, Local Centre level and Sub-Centre level as the most authoritative repositories of knowledge related to the diverse activities embraced by our profession and to the development requirements of each State and region. In this context:

❋The Institution should play an increasing role in identifying the needs for manpower development connected with economic development

❋It should interact with other disciplines and professions in all multidisciplinary areas including the administrative and political systems by organizing seminars and workshops on technological and economic alternative strategies

❋It should organize 'Continuing Education Courses' for practising engineers with the active cooperation of the academics at the State Centre level. The aim of these courses should be to make the professional initiate technological change

❋ It should constantly re-assess the quality of the educational and training system and ensure that the requirements of leaders of the profession by the turn of the century are adequately met with

❋It should evolve a plan and create an overall environment of innovation, design ingenuity and constant research in the profession so as to develop a strong qualitative base for the country's large scientific and technical manpower. Engineering design capability should become a professional requirement

❋In each field of professional discipline, the Institution should identify critical areas for conservation of our scarce resources — fiscal, material and manpower — to make our efforts more productive

❋It should evolve a system for professional reccgnition of innovators

In achieving the above objectives, the State Centres and the individual members of the profession should plan their activities at least two to three years ahead. It is needless to say that the image of the Institution is nothing but an integrated function of the image of the State and Local Centres.

In the recent past, the planning of technical activities of the Institution through the Division Boards and the Committee for Advancement of Technology and Engineering (CATE) has shown definite results. The Institution should now give a sense of direction to the Technical activities at the State level. The Enqineers' Day organized at tile State Centre level has shown how we can involve our professional colleagues. One good quarterly seminar and six continuing education programmes a year with the usual lecture meetings and film shows and technical visits should be the minimum norm for the State Centres.

Similarly, planning of activities for students and technicians should also be the responsibility of the State and Local Centre committees. I am sure the Council will use all its knowledge resources for achieving the above objectives.

In closing, let us remind ourselves that in honouring the engineer-statesman, Sir Mokshagundam Visvevaraya, the Institution has been reminding itself, year after year, of the stature to which the profession can rise. When opportunities came in his way, Sir Mokshagundam lost no time to make his mark. Similarly, when opportunities come in our way — to many of us in positions of authority, knowledge and influence — we should lose no time not only to impress upon the decision-makers the need to take consensus decisions which can make the nation's objectives very clear but render our team-work easy in achieving the goals on which the nation is set.

Let me conclude by re-emphasizing that 'knowledge knows no barriers'. There cannot be any administrative or other sort of insurmountable barriers to men of knowledge. Let us therefore shed the feeling of helplessness and march ahead. May the profession gain in stature as an innovative, problem-solving, productive fraternity.

Thank you.

1 Population Projection AD 2000

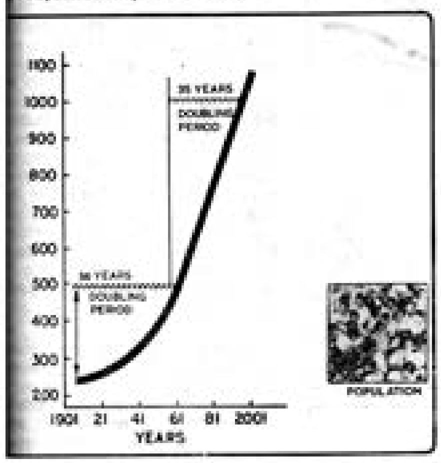
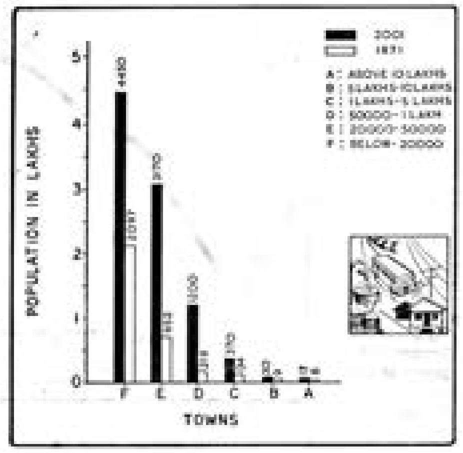


Fig 2 Movement of Population



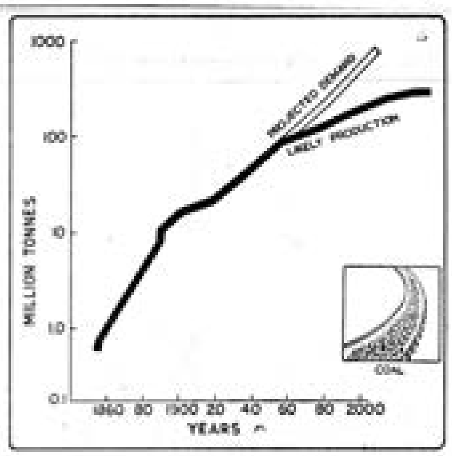


Fig 3
Demand and
Supply of Coal

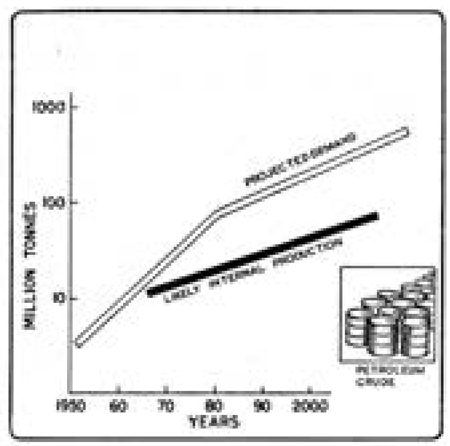


Fig 4
Demand and
Supply of Crude

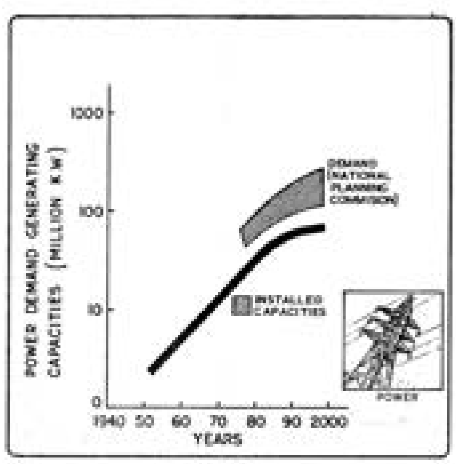


Fig 5
Power Demand
in India

Table 1 Growth and Distribution of Urban Population—1961-2001

	MODEL 'A' REGISTRAR GENERAL'S ESTIMATES				MODEL 'B' PROPOSED TARGETS			
Year	Population million	Decadal increase, %	Urban, %	Consequent Rural Population millions	Population millions Decadal	Growth, %	Urban, %	Desirable Rural Population
1961	79	26.4	18.0	360	79	26.4	18.0	360
1971	109	38.2	19.9	439	109	38.2	19.9	439
1981	150	37.6	22.5	518	165	51.3	24.7	503
1991	205	36.7	25.6	596	265	60.6	33.1	536
2001	273	35.6	29.4	667	445	67.9	47.1	500

Table 2 Population, Gross Domestic Product and Value added in Mining and Manufacturing and in Agriculture in 2000 (Gross product at factor cost at 1970 prices, million rupees)

	1970	Scenario 'A'	Scenario 'B'	Scenario 'C'	Scenario 'D'
'GDP'	362	1051	1082	1560	1560
Mining and Manufacturing	53	202	231	376	408
Agriculture	174	422	399	505	471
Population, million	579	1034	917	1034	917
'GDP' per capita, Rs	630	1025	1187	1520	1712

Table 3 Electricity Capacity and Generation

	1960-61	1974-75	1975-76	1976-77 (provisional)
Installed capacity, million kW	5.6	20.2	22.2	23.4
Public utilities	4.6	18.3	20.1	n a
Self-generating establishments	1.0	1.8	2.0	n a
Generation, bkWh*	16.9	70.7	79.8	89.3
Thermal**	9.1	40.7	44.0	51.2
Hydro	7.8	27.8	33.2	34.8
Nuclear	—	2.2	2.6	3.3

*Public utilities only. **Including oil and gas

Table 4 Consumption of Petroleum Products, in thousand tonnes

	1965	1970	1975	1976
...ht distillates	1 361	2 575	3 549	4 017
of which				
Naphtha	30	837	1 814	2 188
Motor gasoline	1 093	1 411	1 259	1 309
...dle distillates	6 186	8 870	11 546	12 370
of which				
Kerosene	2 526	3 262	3 031	3 288
High speed diesel	2 327	3 735	6 585	6 943
Heavy ends	4 321	6 143	7 230	7 277
of which				
Furnace oil	2 888	3 495	4 291	4 238
Refinery boiler fuel	411	1 147	1 216	1 271
Total	12 279	18 735	23 541	24 935

Table 5 Coal Production—Targets and Achievements

Plan period	Target	Achievement, million tonnes	Extent of shortfall, million tonnes
1951	—	34.98	—
1955-56 (First Plan)	39.00	38.23	— 1.97
1960-61 (Second Plan)	60.00	55.72	— 7.1
1965-66 (Third Plan)	97.32	67.74	—30.39
1973-74 (Fourth Plan)	93.50	78.17	—16.4
1974-75 (Fifth Plan)	90.00	88.41	— 1.8
1975-76 (Fifth Plan)	98.00	99.63	+ 1.7
1976-77 (Fifth Plan)	108.00	101.27	— 6.2

Table 6 Non-commercial NCAER Data

Fuel			Estimated demand: Natural—in units, million tonnes	Estimated demand: In coal replacement, million tonnes
...arcoal	...	...	0.27	0.313
...ewood	...	...	112.37	62.01
...ng cake	...	...	60.57	21.34
...getable waste	...	...	33.51	15.63

...ble 7 Demand for Energy in India in AD 2000 with Historical Comparisons (million tonnes coal replacement equivalent)

	1970	SCENARIO 'A' Low	SCENARIO 'A' High	SCENARIO 'D' Low	SCENARIO 'D' High
Commercial Energy					
...ufacturing and mining	79	313	320	658	689
...sportation	65	206	246	380	446
...sehold	35	119	134	154	233
...iculture	9	71	86	79	208
...cellaneous	12	37	41	69	82
Total	200	746	827	1 340	1 658
...-Commercial Energy	192	339	323	300	221
Total Energy	392	1 085	1 150	1 640	1 879

Fig 8 Source-wise Demand for Commercial Energy for Direct Use

	1970 mter	SCENARIO 'A' mter	SCENARIO 'A' Growth	SCENARIO 'D' mter	SCENARIO 'D' Growth
Electricity	49	373	7	791	10
Oil Products	97	356	4	669	7
Coal	54	98	2	198	4
Total	200	827	5	1658	7
'GDP' million rupees	362	1051	4	1560	5

Source: R Nagarajan. 'Energy: Year 2000 AD'. Operations Research Group, Baroda, April 1975.

Table 9 Demand for Energy Resources in AD 2000

	1970	Scenario 'A'	Scenario 'D'
Total energy, mter	392	1 150	1 879
Commercial energy, mter	200	827	1 658
Electricity Generation, bkWh Hydro	25	155	* 220
Nuclear	2	66	138
Thermal (Coal-based)	34	215	566
Total	61	436	924
Coal, mt**			
Direct energy use	57	98	198
For electricity	17	139	361
Non-energy use	—	14	30
Total	74	251	589
Oil, mt			
Direct energy use	16	48	92
For electricity	—	4	11
Non-energy use	3	8	14
Total	19	60	117
Non-commercial energy, mter	192	323	221
Firewood, mt	131	204	139
Dung, mt	72	121	83
Vegetable wastes, mt	40	85	58

**Relates to 1969-70.

Requirement for specific fuels has been projected for the two extreme scenarios taking into account requirements for primary fuels for electricity power generation and for non-energy uses.

Table 10 Source-wise Demand for Commercial Energy for Direct Use in AD 2000 by Consuming Sectors

	Industry	Transport	Domestic	Agriculture	Others	Total
Coal	138	4	35	—	21	198
Oil	34	425	117	72	21	669
Electricity	517	17	81	136	40	791
Total	689	446	233	208	82	1 658

Presidential Address
(1981-82)

ENGINEERS — AN INSTRUMENT OF CHANGE

Last year, when I addressed the 60th Annual Convention, I briefly touched upon the role of professionals — men of knowledge — in national development. The engineering profession has been in the forefront of development and it has been the responsibility of this profession to give the best return for the capital invested.

The profession of engineering has always been a dynamic profession. As the knowledge of materials and application of materials keeps on enlarging, the engineer is called upon to transfer this knowledge to the field so that the benefit can accrue to the country. This is a profession where technology updating becomes the prerequisite to successful practice of the profession.

Writing about environment and evolution, Jonas Salk, renowned physician-biologist and developer of anti-polio vaccine, states:

'From time to time we sense new urges and desires, new forces that have arisen from within, in relation to environment. These manifestations create additional problems or challenges and require that we constantly cope with new situations . . . . At any point in our lives, we know what has happened in our development but not what will happen in the future. And yet we would like to know what to do, what role to play in determining our own future'.

Jonas Salk was referring to his own field of research but his statement applies equally to engineers who are constantly engaged in search for new solutions to changing problems.

During the two decades of the post-independent India, persons of my generation greeted the emerging R&D and industrial infrastructure created by late Pandit Jawaharlal Nehru, as a visionary's approach to the development of a strong scientific and technological base for the country. Our technological self-reliance was expected to come out of the work done in this infrastructure. For this purpose, considerable financial investments have been made. The equipment and facilities in these laboratories can be the envy of the third world. Yet there is a feeling amongst many in the profession that the contribution we are making towards enriching the knowledge of engineering application is not adequate compared to the magnitude of the problems even in the priority sectors of water and soil management, habitat transportation and energy. This feeling may be partly due to inadequate communication between the users of R&D effort and the R&D establishments themselves.

At the dawn of the fourth decade of Independence. we are meeting to review our strengths and weaknesses in this vital area of research and development in engineering. The Institution has been for some years in the Committee for Advancement of Technology and Engineering (CATE) discussing this trend. Attempts are being made to identify specific problems which are considered a deterrent to a dynamic innovative professional activity.

PROFESSIONAL INTERACTION

One of the problems that has been identified is the lack of intensive professional interaction between practising engineers and the R&D institutions. We found that, by and large, our technical paper sessions were of interest only to the engineers working in academic institutions.

Our normal communication medium — the printed journal and the annual paper meetings — did not improve the understanding. We are now attempting more application-oriented presentation techniques in our Workshops and Seminars. This has attracted a great deal of

The most imperative change is in the system of administration. Once the policy decision is given, the engineer must be held completely accountable for time and costs. He must be trusted and given the necessary responsibility. The present system protects the inefficient and frustrates the intelligent.

active participation. This experience has made us to attempt an R&D meet, where we have tried to bring to the practising professionals the information about national R&D programmes. We have also invited leaders of the profession to indicate the development perspective to R&D workers. We have documented our successes and, in the light of this experience, discuss our failures and analyse the causes for failures. The entire session will be introspective in nature and I do hope it will give us a new experience in learning.

DEVELOPMENT PROBLEMS

The development problems of this country, which I briefly referred to in my last year's address, need to be understood by the profession. Most of us are happy to carry on the routine and maintain status quo. We must look inside as well as outside for the remedy of the problems with which we are confronted. Often, we know what to do but we do not know how to do it.

How can we accomplish our tasks? All work is done by those who are inspired. This inspiration must be recognized and encouraged. Above all, emphasis must be placed on motivation and attitude as well as upon intellectual ability. A combination of imagination and the capacity to act with skill and technical competence is necessary.

INNOVATION AND CHANGE

Great changes in technological development have been brought about only by those who have felt great urges from time to time. New forces have arisen from within, in relation to the environment. Our potential emerges in relation to our environment. We have to understand, therefore, the relationship between the profession and its environment, so that we are able to deal better with the internal and external factors with which we are confronted. We need the type of understanding that would make us innovative and instruments of change. Engineering is an experimental science. Through the experience of many opportunities, we begin to recognize how our capabilities, particularly innovative capabilities can emerge. In this way, we may find that we have vast potentialities and that there are many different ways in which we can express these.

In this process, we must remain aware of the need to match our potential with favourable environmental influences. When such a rapport occurs, we must seize the opportunity to go forward towards development. In this process, we naturally depend a great deal upon our colleagues who provide political leadership and those who are in the administrative hierarchy to help create a favourable environment. Our relationship should be such that we provide the propelling force and the political and administrative colleagues act as two wings to provide stability for the system. I have used the anology of an aircraft so that we realize that in the absence of stability, we will be grounded and never take off.

In this context, I venture to suggest that the Government should have a hard look at our administrative system. The system is tending to become too manual or code-oriented and procedure-dominated. In many cases, the time taken to process a decision — a technical decision — is so long that the advantages of new projects do not accrue to the citizens. I am referring to the enormous delays at the stage of project formulation and project execution. The financial control system and the concept of accountability need to be revised to enable the project executive to accept accountability. In the present system, no one is accountable for delays and co t escalations. Similarly, transfer of key personnel in large projects and injecting new persons without adequate experience is not a good management concept. The second in command must always be trained and ready to take charge. I am sure, these matters are constantly being debated at various forums of the Government.

Our interaction with development agencies and practising engineers will be structured to fulfil the basic goal of bringing about an environment for innovative change.

Time is the essence of our resources. We have with us 30 years of experience and we should learn by it. If the experience calls for a change for the better, we should strive to bring about this change. We have a responsibility for the future which we must accept and hence not resist change. The most imperative change that I would urge is the change in the system of administration. Once the policy decision is given, the engineer must be held completely accountable for time and costs. He must be trusted and given the necessary responsibility. The present system, I am afraid, protects the inefficient and frustrates the intelligent.

Many of us fear change, we feel secure in the present and permit inertia to take command of our intuitive and innovative mind. But, we have a responsibility to ourselves and to society. Engineers today have such an opportunity to shoulder responsibility. I would therefore call upon the members of this chartered professional organization to willingly organize themselves to be instruments of change.

‘Whatever is regarded as 'worthy of change' constitutes a challenge, writes Jonas Salk. 'A challenge is, characterized, by one's attitude.' and the question arises: can we take up this challenge? I would like to emphatically say—yes—we can and we should.'

THE TASK AHEAD

When I spoke to you last year, I presented to you a perspective of growth in the next two decades and emphasized the nature of technological problems the country will have to tackle as a result of population movement. Since then, the draft Sixth Plan has been finalized and the planners have initiated a series of dialogues with professional societies.

The Institution was invited for a dialogue with the Planning Commission and has subsequently had a separate discussion. In these discussions, we have reiterated the approach of the Institution to problems of development and also placed at the disposal of the Government the large infrastructure of its professional membership. We have offered to act as a catalyst to create an environment of change and innovative dynamism. We have offered to educate our profession in management of technology at the field level.

The priority sectors identified by the Council are water resources development, soil and water management, warehousing, habitat, transportation, energy and education. Industrial technologies will continue to receive due attention but emphasis will be on conservation of resources for development, quality and reliability. In all these areas our interaction with development agencies and practising engineers will be structured to fulfil the basic goal of bringing about an environment for innovative change.

Civil engineering colleagues in the building industry should adopt new techniques of building research on a large scale.

Research and development activity in engineering lays the foundation for technological change and an innovative environment. R&D management in India, at the moment, has not been able to ensure that the linkages between the establishments and the pracing profession are adequate. professional meetings, we hardly notice any structured attempt to market R&D results. This has had a negative effect. The practising professional feels that the ideas coming out of the laboratories are not fully tested and therefore he hesitates to put to practical use this technological change. We must eradicate this impression in a systematic manner.

Our energy planning should contain both elements — the decentralized energy sources, including renewable sources of energy, for low to moderate loads and large systems for highly concentrated industrial loads.

In the area of building sciences, the work done in the national, laboratories has mostly remained in a pilot plant stage, even though we see spiralling costs of construction with conventional building materials and increasing housing shortages. Before the problem really becomes totally unmanageable, I would plead with my civil engineering colleagues in the building industry to adopt new techniques of building research on a large scale. We surely would not be taking extraordinary risk when we recall that the temporary structures put up in the forties all over the country have lasted almost 40 years. In any case, the urban scene indicates that where the engineers fail to take risks, the homeless take the risk and build huts and create public health problems. Can we therefore consciously refuse to learn now to face challenges?

Similarly, in the area of energy, we have followed the pattern of development of large central project involving huge investments. The cost escalation in these projects and the slippages in time have eroded the anticipated benefits and consequently the investments are not giving economic returns. Therefore, I strongly plead for extensive decentralized energy plan which can be designed, developed and executed by a large number of agencies and also manned by technicians all over the country. The super thermal stations and grids have a role to play in future and the work on them should continue. But transmission and distribution of energy over long distances to low density consumption centres may not prove to be a desirable economic option. Therefore, our energy planning should contain both elements — the decentralized energy sources, including renewable sources of energy, for low to moderate loads and large systems for highly concentrated industrial loads. I would also plead that our planning should include all forms of energy including solar, bio-gas, etc. The present organization leading to specialization at the management level, such as electrical systems and non-electrical systems, also needs restructuring. It is desirable to involve the consumer more and more in becoming partner in development.

We have made substantial investments for developing indigenous capabilities in the energy sector. This investment will give satisfactory results, if it is nursed and given specific goals to be achieved. Instead, I see, as in other fields, an impatience to inject imported technology, equipment and skills. This approach is in direct conflict with the national goal and long-term objective of self-reliance.

The area of soil and water management continues to be a priority area to enable the new agricultural technologies to spread all over the country. We should work very closely with agricultural technologists to ensure that the scarce water resource is optimized for use in a wide area. The experience of command area development has also brought into focus the interdisciplinary approach to agricultural development. Agricultural engineering therefore encompasses a very wide spectrum of interdisciplinary activities from groundwater development soil and Water management, farm mechanization and warehousing to mechanical handling. R&D efforts in all these areas must be focused for the benefit of the agricultural sector so that the country not only feeds the population but also produces surplus for export. Industry based on agricultural products is expanding rapidly. R&D inputs into this area need to be accelerated.

Industry based on agricultural products is expanding rapidly. R&D inputs into this area need to be accelerated.

TRANSPORTATION TECHNOLOGY

Rising costs of energy and the dependance on imported fuel makes the transportation sector a very critical area in the next two decades. Our investments in this sector continue to be accorded a lower priority. India is a country of distances. Our fossil fuel resources need to be transported over long distances calling for high transportation costs. Our agricultural and industrial production comes from highly developed pockets in the country and they depend a great deal on an economical, fast and reliable transportation system to reach destinations. Our present mix of road, rail and air is not an optimized mix from any point of view. It is lagging behind in capacity. It is energy intensive. It is not wholly reliable. Our economy can grow only if the transportation sector can grow faster with systems known for their fuel efficiency. The work in our national R&D units in the transportation sector, viz, RDSO, Automobile Research Station, Central Road Research Institute, and National Aeronautical Laboratory should devote sometime for analysing our foreseeable problems in this sector and develop an Integrated R&D plan for the transportation sector. Hauling large volume of goods by roads, faster movement of rail rolling stock over long distances, containerization of the goods for movement by road, rail or air, development of water transportation system wherever feasible and conservation of energy in all modes of transportation, are some of the priority areas deserving the attention of our engineers. The work in various R&D units must form part of a comprehensive plan to integrate itself into our national objective.

Our economy can grow only if the transportation sector can grow faster with systems known for their fuel efficiency.

Technology and development are interconnected. The process of development does not limit itself to a five-year document. It is a continuous process. Hence a national objective must be accepted by all political parties and irrespective of the Government in power the priorities should remain unchanged till the objective is achieved. Unfortunately, in our country, the political changes or changes in minister also bring about changes n priorities of projects with far-reaching consequences thereby denying the common man the fruits of development.

THE ROLE OF THE PROFESSIONAL SOCIETY

I started this address by briefly referring to the role of the professional. Now, I would like to address myself to the membership of this Institution. The CATE and the Council have been deliberating on the effectiveness of our programmes to bring out the best in our membership. As a professional body, the Institution of Engineers (India) is concerned with the problems of development in the country. Its involvement, therefore, is in the following specific areas:

1. Fostering the growth of engineering design and consultancy service capabilities
2; Building up of appropriate information systems
3. Relevant training and continuing education programmes for professionals
4. Assisting in choice of technologies for development
5. Assimilation of programmes for imported technologies
6. Generation of technologies appropriate for development
7. Involvement in the internal diffusion of technologies

The National Design & Research Forum (NDRF) of the Institution, which was established 15 years ago, is today the nucleus of a professional forum for R&D engineers. Its main activities are to :

(a) Encourage the creative and the innovative talents to Interact with the profession
(b) Provide a communication media by way of the specialist journal Engineering Design
(c)Professional recognition of outstanding R&D effort by sponsoring national awards
(d) Establish design awareness among students by organizing annual design competitions
(e) Act as a link to expose practising engineers to new and emerging technologies
(f) To undertake techno-economic feasibility studies for different agencies including

Government bodies
(g) Act as link between the R&D establishments and the profession to assist in smooth transfer and absorption of technology.

The limited experience gained in the last 15 years has brought out the following factors:

(a) The thirst for knowledge among practising engineers is enormous.
(b) The resources of the professional body to quench this thirst are limited.
(c) The practical difficulties in transfer of technology are beginning to be identified.
(d) The role of the professional engineer in training his men for absorption of technology is getting defined.
(e) Industry's involvement in the programmes of the Forum IS increasing.
(f) The country needs regional forums for accelerating the dissemination of knowledge.

Arising out of these findings, the Council of the Institution has now set new guidelines for all its Centres. These include:

(a) An indepth study of available R&D facilities in each state
(b) Establish linkages with these establishment sat the State level
(c) Classify the current R&D programme in each institution to suit the needs of the practising engineers
(d) Organize R&D workshops in specific areas for dissemination of knowledge and help in transfer of technology.
(e) Publish reports of success stories in the Institution publications
(f) Bring out special issues of *Engineering Design* in specific areas
(g) Develop design data sheets for use by Industry
(h) Arrange R&D meets and State-of-the Art reviews at national level once in two years. In specialized areas, create separate forums and study groups for continuous study, eg, the EHV Forum
(i) Encourage interdisciplinary interaction in all programmes by active co-operation with other professional societies, eg, bio-medical engineering, agricultural technologists, textile technologists, etc.
(j) Work closely with academics in education and training programmes (IISc and IITs).

What we need in india today is an environment of change to speed up the process of development.

The major thrust of the programme will be to help and expedite the transfer of technology from the national laboratories to the field. The conservatism of the practising engineer arising out of the system constraints needs to be changed to enable him to take risks while innovating and initiating changes. What we need in India to day is an environment of change to speed up our process of development. In our national paper for UNCSTD we have stated thus:

'An incisive scrutiny into the appropriateness of technologies and a derivation of the criteria of appropriateness from a definition of development objectives, together constitute a fresh approach to the integration of science and technology with development.

The starting point of such an approach is the concept of development in terms of new orientation, self-reliance and ecological soundness'.

From the point of view of the Institution the priorities are:

1. To develop rural settlements with basic public health standards;
2. To decerrtralize energy systems for such settlements;
3. To develop cost effective industrial technologies for production of consumer durables, with

emphasis on energy conservation;

4. To evolve an integrated national transportation system linking the animal drawn vehicles to energy efficient cargo movement systems;

5. To develop warehousing and storage facilities for agricultural produce to ensure an adequate return to the farmer which would stabilize our economic system for rapid growth.

6. To bring into use the computerized technology for handling the tremendous volume of work in servicing the needs of the people in service industries;

7. To inculcate an awareness about quality and reliability and discipline associated with absorption of technologies; and

8. To organize manpower development and training for handling the technologies of the next decade.

I have enumerated a few important priorities. Our programmes may cover many other highly sophisticated areas. But the thrust of the large membership will be in areas where transfer of technology is urgent to solve the enormous problems arising out of population growth, movement and education. Improvement in literacy has brought an increased awareness In our people and the resulting political and socio-economic pressures can be successfully handled by organizing ourselves to rapidly transfer, appropriate technologies for the benefit of the masses In the shortest possible time.

I look forward to the State Centres and the local leadership for more involvement in problems of development.

Thank you'

Shri S G Ramachandra — a Brief Profile

After a brilliant academic career in the University of Mysore — (BE Electrical) and post-graduate study and training at the Indian Institute of Science (AIISc) — Shri Ramachandra (born August 6, 1924) joined Kirloskar Electric Co Ltd as Design Engineer. His early industrial training took him to the works of Brush Electrical Engineering Co Ltd in the UK. Reinforced by this experience and his own rich technical resources, he developed the Engineering Department of the Kirloskar Electric Co into a strong design group achieving rewards in terms of import substitution and indigenous development so important to the nation in its industrial and economic progress.

Shri Ramachandra became Chief Engineer of his organization in 1958 heading all the product divisions. His contributions went a long way in helping the company's rapid growth during these years as well as its diversification into many product areas. As an outcome, the company received Presidential Awards for import substtution twice. In 1970, Shri Ramachandra was entrusted with additional responsibilities and was placed in charge of the company's operations. In 1978, he was raised to Senior Vice-President of the organization,

Shri Ramachandra's involvements in the nation's industrial front have been immense. In serving this cause, he has been in continuous interaction with many national organizations such as the Indian Standards Institution (ISI), Department of Science and Technology (DST), National Laboratories, etc. Among his noteworthy involvements may be mentioned the leadership he has given in the formulation of Indian Standards for Electrical Machinery; his close association with many of the Industry Conferences planned and organized by the Indian Standards Institution; and his expert advice to the Karnataka State ISI Advisory Committee, as its Chairman. Presently he is a Member of the Executive Council of ISI and also the Chairman of its Electrotechnical Division Council. Further, he is the Chairman of the ISI Rotating Machinery Sectional Committee.

Shri Ramachandra is variously connected with the working of the Indian Electrical Manufacturers Association (IEMA) where he has outstandingly sponsored its work on industrial standards. He headed several IEMA Panels, as on Transformers and Rotating Machinery making notable contributions. He also represented the IEMA on the Certification Advisory Committee of the Indian Standards Institution. He has been an active member of the IEMA Executive Council and is currently a Vice- President of the same.

He is an active member of the Executive Committee of the Sub-Regional Committee of the Association of Indian Engineering Industries (AIEI) and heads its Energy Panel. His advice is constantly sought by the Karnataka Federation of Chambers of Commerce, the Karnataka State Small Industries Service Association and other like organizations. In great appreciation of his efforts, the Karnataka Government thrice nominated him as a Director of the Small Industries Development Corporation, Karnataka; and also on the State Advisory Board for Small Industries and the Visvesvaraya Trade Centre.

He is also representing the Institution at the Ministry of Industry as a member of the Development Council for Heavy Electrical Industries. In this capacity, he initiated and has progressed much work related to technology development with a view to drawing up a perspective for solving identified problems of industry. In recognition of his outstanding work, the Government has re-nominated him as a member of the reconstituted Development Council for Heavy Electrical Industries. In a similar way, he has also served the Directorate General of Technical Development as a nominated member of many of its Study Committees. Devoting himself actively, he has very richly contributed to the work of: conservation of copper, modernization of designs for small scale industries, and revitalization of the electrical industry's testing and evaluation facilities.

Research and developmental work has been close to his heart all the time. He was intimately associated with the work of creating and organizing the Electrical Research and Development Association (ERDA) sponsored by the IEMA and he is presently the Vice-President of ERDA. In recognition of his wide and varied background, profound knowledge and immense experience in industry and its technological development. the Department of Science and Technology. Government of India. entrusted him with the responsibility of heading its Panel on 'Reliability of Electrical Equipment'; and in this office. he put up stupendous work achieving many creditable results. He is a member of the Karnataka State Council of Science and Technology and also of its Executive Committee. Another distinguished office he holds is the Chairmanship of the Electrical

Engineering Research Committee of the Council of Scientific and Industrial Research (CSIR).

He represents the Indian industry on the Committee for Evaluation of Post-Graduate Technical Education in the country. He is a member of the Board of Governors of the Regional Engineering College, Suratkal; the Indian Institute of Management. Bangalore; and the Institute for Social and Economic Change, Bangalore. He is also a member of the Visvesvaraya Industrial and Technological Museum of the Ministry of Education at Bangalore. as well as Chairman of its Scientific Committee. Further, he is president of the Mysore Technical Education Society and President of the Governing Council of MEI Polytechnic. Bangalore. He was a member of the Tariff Committee of the Karnataka State Electricity Board in 1978 and became a member of the Committee for Studying the Pattern of Industrial Development vis-a-vis Energy Availability in Karnataka in 1979.

Shri Ramachandra joined the Institution of Engineers (India) as an Associate Member in early 1952 and was invited to join the local executive committee of the Mysore Centre (now Karnataka State Centre) in Bangalore and guide the organization in its technical and professional programmes. His devoted services — as joint Honorary Secretary for many years and as Honorary Secretary for four years — to the cause of the engineering profession received much appreciation; and later he was chosen Chairman of the Centre and held that office for two years. He was first elected to the National Council of the Institution for a four-year term from the State Centre and next for another four-year term as Chairman of the All-India Electrical Engineering Division.

During his tenure of office in the State Centre, he triggered off innumerable technical activities, both regional and national. and so great was the success and achievement of these activities that they are even today followed by many other Centres of the Institution as invaluable examples to emulate.

He also successfully built up a team of professionals from industry. the government and the academies to responsibly project professional views on many crucial aspects of development in the State. Realizing the usefulness and importance of this endeavour, the State Government extended its fullest support to the activities of the Institution, using its forum for public debate on many important issues related to the State's welfare and inviting the Institution to join many of the Government Committees and Panels which focused attention on the State's industrial development and engineers' contribution towards it.

Creating altogether a new impact on the membership in these assignments, Shri Ramachandra has built in a new dynamism to the technical programmes and learned activities of the Institution. He introduced the concept of organizing interdisciplinary seminars as a result of which National Seminars of the Institution have gained countrywide praise and participation. Shri Ramachandra is also responsible for the unique importance he has brought to the Engineers' Day, which affords a great opportunity to all the Centres to collaborate with the public in debates on national problems.

As Chairman of the Electrical Engineering Division, Shri Ramachandra's persuasive drive on advance planning has gone a long way in revitalizing the Institution into a new role in the field of technical communication and information dissemination both at the national and international levels. As a result, the Institution's activities are not only getting increasing recognition but have been continuously attracting greater participation of overseas professionals and experts in engineering. Further, his idea of organizing technical activities throughout the year in different parts of the country has thrown open a wide vista offering numerous opportunities equally to the industry, academies and engineers to come in close contact with each other and benefit themselves through mutual exchanges on new technologies and the latest technological developments in India and elsewhere.

Ever eager to build a creative team composed of talented engineers, young and old. Shri Ramachandra was the first to go ahead with the significant task of creating such a nucleus In the National Design Forum functioning at Bangalore under the aegis of the Institution. He has not. only been expertly guiding the work of the Forum but is the Technical Editor of its quarterly journal, Engineering Design. The Design Competitions in various engineering disciplines being organized by the Forum have been offering wide opportunities to talented students to win meritorious prizes. Shri Ramachandra's personal contribution of Rs 25000 to establish a prize fund for the above purpose has proved invaluable in many ways, not only by attracting similar funds through external help but by helping the profession to locate young and innovative engineers throughout the country. The creation of the National Design Award bestowed on outstanding engineers by the

Forum at Annual Conventions bears yet another testimony of Shri Ramachandra's innate interest to make the Institution serve as an effective mechanism for perpetuating our professional values and technical commitments for the foreseeable future.

Shri Ramachandra is a close partner in the International work of the Institution and has been rendering yeomen service through its Indian National Committees. Shri Ramachandra is deeply involved in the energy field both nationally and internationally. With a devotion and commitment all his own to the cause of energy vis-a-vis people, he has been invaluably contributing as: the Chairman of the Standing Committee on Energy Problems of Developing Countries of the World Energy Conference; as the Chairman of the Indian National Committee of the World Energy Conference; as a Member of the Committee on New and Renewable Resources of the Department of Science and Technology, Government of India; as a Member of the Committee for Energy Utilization of the Karnataka State Government; and as a Member of the Energy Panel of the Associated Chambers of Commerce and Industry of India.

He led the Indian delegation to the World Energy Conference held at Istanbul, Turkey, in 1977. Further, Shri Ramachandra was the head of the Indian delegation to the meeting of the International Executive Committee of the World Energy Conference at Dresden during September 1979, where a historic decision to hold the 12th World Energy Conference in India has been taken. His prestigious paper on 'Non-Commercial Energy' at the 11th WEC, held at Munich in September 1980 — the preparation of which was assigned to him by the WEC — brought in a new awakening to the world on the energy concerns, priorities and prospects of the developing countries.

Rightly enough, Shri Ramachandra's dedicated work and expertise have been recognized by many quarters. In 1975. he received the FIE Foundation Award of Rs 25000 for his outstanding contributions in the field of electrical engineering.

Shri Ramachandra is a keen and active Rotarian and social worker and in consonance with the objective of the Rotary movement. he has been responsible in organizing numerous vocational training programmes for industrial labour in new and developing technologies. He is currently working on schemes to improve the quality of instruction and training programmes for self-employed artisans and technicians. He has successfully organized a co-operative front and simultaneously a base for mutual help whereby unemployed engineers are patronized by the government and other organizations and beneficially employed by them. He has also identified himself personally with the work of many cultural organizations, cooperative banking, etc, and has been serving them with distinction. He was President of the Karnataka State Natya Sangha and the Century Club, Bangalore. He is the Honorary Treasurer of the Karnataka Amateur Drama Association and the Gokhale Institute of Public Affairs, Malleswaram, Bangalore. He is President of the Popular Science Forum. Bangalore; and President of the Bharat Sports Union. Bangalore. He is also a Past-Chairman of the Institution of Standards Engineers, Bangalore Chapter.

Shri Ramachandra is an eloquent speaker and first class writer. While he has contributed valuably to technical literature. he has also addressed innumerable national and international gatherings on widely varying subjects.

Reputed for his perseverance and persistence in carrying out his mission. characteristically selfless, unobtrusive and unassuming, Shri Ramachandra is a many splendoured personality in his own right. much loved and respected In the profession. His re-election has indeed come as a momentous and renewed recognition of his distinguished attainments and underscores the Institution's commitment and continuing efforts to assure the highest level of technical excellence and professional competence in serving the nation: We hope that under his further dynamic lead, the profession will reach greater heights in fulfilling the nation's aspirations.

Dr Shankar Lal

President 1982-83

Presidential Address

I stand here in all humility, honoured by my election as the President of the Institution of Engineers (India) for the current term. And even as I thank the members of the Council of the Institution, and through them the members of my profession throughout the country, for the great confidence they have reposed in me. I am deeply aware of my own shortcomings in shouldering the heavy responsibilities that go with this high office but I can assure you that I shall do my very best to prove worthy of your choice and work hard for the Institution and the ideals it stands for; and I feel certain that with the active assistance and continuing cooperation of my colleagues in the Council. I shall be able to serve the entire engineering fraternity of the country to their satisfaction.

As I address the distinguished assemblage on this, the Sixty-Second Annual Convention of the Institution; I am moved by a sense of occasion. I am fully aware of the solemnity that attaches to these annual conventions; I know that they provide the fraternity with an opportunity for an examination of past performance and planning for the future; for a hard and close stock-taking and a renewal of faith in the days to come. If these conventions are solemn occasions they are also joyous events which enable the profession to meet, exchange notes and thereby highten the awareness of our common ideals. And quite apart from this, these conventions are also a part of a transition process of the Institution where the orderly transfer of authority from one President to the next takes place.

I take this opportunity to convey our sincere gratitude to Shri S G Ramachandra, my distinguished predecessor who, through his dynamic leadership and selfless service, has served the Institution so ably for the past two consecutive terms. I wish to assure him that I shall strive my utmost to maintain the high standards he has set for conducting the affairs of the Institution.

It is a matter of great satisfaction to us all that His Excellency Air Chief Marshal O P Mehra, is with us to inaugurate this Annual Convention. His August presence here today is a sure indication of the love and esteem he has for us as partners in the Government's effort to serve the people and improve their lot. On behalf of the Institution and on my own behalf it gives me great pleasure in expressing our, gratitude to you, Sir, for your inspiring presence in our midst. It is also my privilege to convey our grateful thanks to our past Presidents, other dignitories, distinguished guests and members of the Institution who have travelled from far and near to grace this occasion with their presence.

As I exercise the privilege of addressing you as your new President, I cannot help being aware of the large, almost endless visit a of purposive action that lies before us. As a professional person it would perhaps be quite in order for me to dwell at length on the particular field of engineering to which I belong. But thereby I would be sidetracking the burning questions of struggle and survival that present-day living in India entails. That, I venture to emphasize, would never do. Engineers do not exist in a vacuum, concerned with pursuit and fulfilment in a world remote from the pains and pressures of the common man's life. The engineering profession would forfeit its claim to the nation's attention if it were to cut itself apart from the broad national goals, pursuing its narrow professional interests in the relative seclusion of its own confines. We must realise that our goals and concerns, such as they are, must interact and intermingle with the all-important goal of bringing to our people the fruits of a better, richer life. Anything that fails to subserve this great national commitment may be rejected by our people as too sectarian to meet the demands of a resurgent nation. It is this realization which leads me to touch upon a few issues that I think worthy of our pointed attention.

EDUCATION-INDUSTRY INTERACTION

'You will bear with me if, as an academic person closely connected with engineering education for the past two and half decades or so, I dwell on this topic for a while. It is said that engineering will be regarded as the most learned profession by the beginning of the next century. The breadth of knowledge needed for practising engineering is not only rapidly increasing but also rapidly diversifying and becoming more and more multidisciplinary. Engineering education must, therefore,· prepare to meet these changing and challenging requirements. Today I wish to bring to your attention only one aspect of these requirements, one that is of concern to both practising engineers and engineering educators alike: the necessity of an active interaction between industries and educational institutes, between 'the world' of work and the realm of research and education, between: the users, of technical manpower and their producers. In the thirty-four years that have gone by since independence, industry in this country has gone through all the rough and tumble that a developing society is subject to. These years have been marked by massive efforts to change the face of this ancient land through well-directed and well-controlled industrialization. Industry today is not just another area of human activity; it is a very basic tool of transformation. In planning our programmes of engineering education this great role of industry must always be kept in mind; their requirements of technical know-how and technical manpower must be met. Since the most important goal of engineering education is to meet these needs of industry, educational institutions must come out of their ivory towers and reorient their thinking and methods. Common objectives must be evolved, the culture of cooperation must be developed and the gap must be bridged. If this is not done much of our engineering education would remain highly theoretical, delightfully vapid, and thus just not relevant to the needs of our people.

I wish to make the above plea with some emphasis because I find in some academic circles an unfortunate resistance to change, a strange insensitivity to the needs of the times. It needs to be appreciated that the nation's industrial growth may at some stage be hampered unless our plans of engineering studies are so tailored as to keep meeting the fast-changing, highly diversified needs of the industry. At the Indian Institute of Technology at Kharagpur, where I have the pleasure and the privilege of working, we are going ahead with a massive programme of purposeful collaboration with industry. Adjunct Professors from industry are being appointed: more and more of our teachers are being sent to industry during vacations; new courses are being started and the curricula of existing courses being revised in consultation with industry; attempts are being made so that student projects are no longer pulled out of academic textbooks but are related to the technical problems faced by industry; a Calcutta campus of the Institute, right in the heart of the industries of the region, is being set up to offer continuing education courses tailored to meet the needs of these industries; the Sponsored Research and Industrial Consultancy Centre is being strengthened; and an Extension Centre is being set up for the-transfer of technology. I believe that this is the right direction in which technical educational institutes should move.

Of course, there is the other side of the coin which also needs careful consideration: the role which industry has to play in furthering industry-education-collaboration. There is no gainsaying that until recently industry has been suspicious of educational institutes and has not cooperated with them in furthering this objective. Industry has to shed this sceptical attitude. It has to put greater trust in educational institutions from which it draws its technical manpower; it has to provide greater facilities to students for planned training programmes; it has to invite teachers to their factories and production centres for get-familiar visits and consultancy assignments; it has, in short, to grasp the hand offered by educational institutions to bridge the gap between them.

PRIVATE COLLEGES AND CAPITATION FEES

While on the topic of technical education there is one more point I would like to draw your attention too. This concerns the proliferation of private engineering colleges in the country with little or no control on the quality of education being imparted by them. Basically, there is nothing against the concept private colleges; they can coexist along with Government run colleges. Indeed, some private colleges have been in existence in the country tor quite some time now and are doing very well. In industry also we have 'private' industries coexisting with ‘public' enterprises; th is concept can certainly be carried over to the sphere of education also. The evil lies elsewhere: in the unwholesome practice of some of these private colleges collecting absurdly high capitation fees from the students who join them, and in the fact that most of these colleges are started on all ad-hoc basis with little consideration for quality and whether the students, they will train fit into the planned development of technical manpower in the country. Capitalizing on the widely prevalent desire for engineering education and the limited opportunities available in the other institutions, these colleges extort huge amounts from parents who surrender themselves to the fleecing process in the hope of bringing their children to the doorsteps of a bright future. We must come down with a heavy hand on this practice of selling and buying of seats in engineering colleges at fabulous prices. This unhealthy trading puts a premium on affulence and bars many who may be more capable in studies but less capable in making huge payments. The practice strikes at the very root of the concept of equality of opportunities to which our country is wedded.

Besides this financial aspect, there is also the aspect of standards: several of these mushroom colleges have very poor laboratory and other essential infrastructural facilities. There is a very strong need for monitoring the standards of instruction imparted in these institution's. Concern of the engineering profession in this regard is reflected in a resolution recently adopted by the Council of the Institution of Engineers. A planned development of manpower, both qualitatively and quantitatively, is essential for the planned development of industries, and no engineering college, private or public, should be allowed to come up without an expert study by the All India Council for Technical Education or some such similar organization.

ENVIRONMENTAL POLLUTION

I would like now to dwell briefly on the problem of pollution of the environment in which we live. No engineer is worthy of being called an engineer today unless he is aware of this problem and is fulfilling his part of responsibilities in controlling and reducing it. Pollution is man-made and man must find ways and means of cleaning up the dirt he creates. A stage has been reached, even in our country, when engineers must sit up and take not of the problem of environmental defilement. If we keep on interfering with nature, exposing the air we breadth and the water we drink to harmful pollutants, we may succeed in building an affluent society with all the amenities of modern living but we shall be left with no healthy, happy people in it. It is not for me to go into the details of the problem and its solution here. I have touched on it from the belief that environmental cleanliness is basic to the fulfilment of our national aspirations for a worthwhile future, and engineers have a vital role to play in this.

CORRUPTION

A social evil which has assumed alarming proportions in the country, and which engineers cannot afford to ignore any longer is corruption. Corruption is rampant today in the country in virtually every walk of life, corroding the basic fibre of the people and making a mockery of moral values. Graft, jobbery, nepotism, jockeying for positions, total disregard of the interests of fellow beings, and various other such corrupt practices are increasingly characterising different facets of our national life. The stage has come when it will no longer do to pretend that the evil does not exist; or to attempt to sweep it under the carpet and forget it. It has to be faced boldly, head on, or else it may soon sound the death knell of all the basic values we cherish. No purpose will be served by one section of the community pointing an accusing finger at the other sections, for virtually every section is equally guilty. Engineers are no exception — we are also involved. I am, therefore, addressing this to ourselves, to first remove the beam from our own eyes before we see the mote in the eyes of our brethren.

I have always believed that there are four steps to self improvement: unconditional admission that a fault exists which needs correction; creation of a genuine desire within us to eliminate the fault; to draw up a plan of action for its elimination; and lastly, to implement the plan. What I am doing today is to make a plea for the first step for us engineers to admit from our innermost conscience that we are also guilty. The other three steps have to be taken individually by each person concerned. Engineers have always given the lead in progressive measures; let us also take the lead in removing corruption from our society. In accordance with the Code of Ethics of the Institutions let us swear that we shall not let ourselves be involved in corrupt practices and shall not tolerate it when we see others practise it. Corruption thrives only in the dark and dingy crevices of society and exposure to public glare is its worst enemy. Let us, therefore, vow to expose it wherever we encounter it.

NATIONAL ACADEMY OF ENGINEERING

It is an unfortunate fact that in our country engineers have not received the recognition due to them for their contributions to nation building. As I look around and observe the national scene I feel confident that the goals of development the nation has set itself can be achieved only if the different sectors of our national life are coalesced into a determined partnership. But keeping engineers out of this will not work, It must be realized that the engineers have the will and the ability to free the masses from the heavy burdens of poverty and squalor. Engineers do not care to join the fray in a mad scramble for power. If engineers ask for power and authority in certain areas, it is because these are necessary for the effective implementation of the tasks with which they are entrusted. Engineers are not interested in power for its own sake; they ask for it as a tool for effective action. And if engineers ask for equal compensation and equal treatment with administrators and others, it is because one cannot expect any section of the community to give of its best for the attainment of national goals and yet face discrimination.

In this connection I wish to plead to the Government for the creation of a National Academy of Engineering, as a sister institution to the Indian National Science Academy. At present the Institution of Engineers, the apex organization for engineers and technologists of the country, is catering to the various technical requirements of the professional community. But the need is being felt for yet another organization which would provide means of assessing the constantly changing technological needs of the nation and the technical resources which should be, applied to meet these needs; to foster interplay between academic attainments and technological temper so as to help the newly emerging technologies to develop and also for exploring entirely new technological horizons; to encourage such engineering research as may be advisable in the national interests; and to advise the Government, whenever called upon to do so, on matters of national importance requiring engineering knowledge. Membership of such an academy would naturally be restricted and could be used to distinguish and honour those engineers whose personal and technical achievements raise engineering to the highest levels. In the USA such an academy was created in 1964; in fact, under the umbrella of the National Research Council of the USA there are three academies: A National Academy of Science, a National Academy of Engineering and a National Institute of Medicine. I urge the Government to give this proposal serious consideration.

POPULATION CONTROL

I would now like to touch briefly on a problem with which although engineers are not professionally concerned, yet it effects them vitally because the success of their efforts is to a large extent dependent on how this problem is tackled by the Government. I refer to the rapid growth of the population of the country which has almost doubled during the thirty-four years since independence. Although there has been a substantial increase in agricultural and industrial production, for which engineers are responsible in no small measure, yet the urban poverty ratio is approximately 50% and rural poverty ratio almost 58%. Today we have as many people below the poverty line as the total population the country had just after independence; and even amongst those who are above the poverty line such large numbers are clustered close to the line itself, that one estimate puts the total number of people suffering from malnutrition and undernutrition in the country at almost 60%. These are staggering and distressing figures. And when these figures are viewed against the backdrop of the significant successes achieved by the country in the industrial and other spheres, surely some awkward questions arise regarding the proper planning of population control. No platform is sacrosanct enough, no occasion too formal where the bane of the baby boom cannot indeed should not, be considered. On behalf of the engineering community I, urge the Government to give much greater stress on the solution to this problem than it has hitherto given, or else all our efforts for planned development will be exercises in futility.

NEED OF THE HOUR

My *alma mater*, the Engineering College of Banaras Hindu University, has 'Work is Worship' as its motto. The University of Roorkee where I worked for nearly 30 years has as its motto words to the effect: 'Nothing is achieved Without Work'. These are not decorative statements to be printed on art paper and put up as wall hangings — they are action principles vital for the very survival of our nation. If the dams and the factories which we build are the temples of modern India, then 'dedication to work' must be the god we worship therein. We must realise that 'isms' can never create wealth — whether it be communism or capitalism or any other 'ism'. Wealth is only created by sincere hard work. We have before us examples of countries vanquished in war, with their economies and industrial capabilities completely shattered, having risen to the very top through sheer hard work. There is no substitute for this; there are no short-cuts. Let us all, therefore, agree to put in our best efforts. The only way to serve the nation is to do the work you are doing, the task that has been assigned to you, no matter how lowly or how sophisticated, to the best of your ability.

The need of the hour is unity amongst ourselves and hard work by each one of us. The Institution of Engineers provides the profession with a forum and a voice. We must use the Institution in assuming leadership roles in various spheres of the country's development and defence. We must learn to give of ourselves. We must accept that the individual owes more to the profession than the profession owes to the individual. We must realise that the prestige and public recognition of our profession would be in proportion to the successes we achieve. I have great hope in the power and idealism that animate the activities of our great profession. Though we have many miles to go in pursuance of our great ideals, I have full faith in our capacity to cross the many milestones that constantly beckon US towards an exciting future. What kept Ulysses going in ancient Greece was a flaming desire to push continually beyond the utmost bounds of human thought. So be it with us.

Jai Hind

Dr Shankar Lal—a Brief Profile

The National Council of the Institution of Engineers (India) is proud to announce the election of Professor Shankar Lal, BSc (Hons) (BHU), DIISc (Bangalore), DIC (London), MSc (Engg) (London), Ph D) (Cal Tech), FASc, CEng, FIE, as President of the Institution for the Session 1982-83. He will take over this high office from Shri S G Ramchandra, Retiring President, at the 62nd Annual Convention to be held at Bombay commencing January 30, 1982.

Professor Shankar Lal brings to the Institution a wealth of knowledge and experience of engineering studies, not only as an eminent scholar and educationist but also as an outstanding administrator, a reputed researcher and consulting adviser. Professor Lal, who is presently Director of the Indian Institute of Technology at Kharagpur, has had a long association with the Institution of Engineers (India) of which he is a member of long standing. He was Chairman of the Roorkee Centre. He is at present a member of the National Council elected from the constituency in Mechanical Engineering and Chairman of the Mechanical Engineering Division of the Institution. He is also a Member of the Committee for Advancement of Technology and Engineering (CATE) and a Member of the Board of Governors of the Engineering Staff College of the Institution.

Professor Lal has distinguished himself as an engineering academician and educationist of international repute. He has been instrumental in effecting a number of noteworthy achievements in different fields of engineering education and research and has held various assignments both at home and abroad. His foreign assignments as UNESCO expert have taken him to the Universidad de Conception, Chile (1967-68); Escuela Polytechnico National, Quito, Ecuador (1968-69); and Instituto Polytechnico National, Mexico City, Mexico (1969-70). He has worked as a Visiting Professor Mechanical Engineering at the Auburn University, Auburn, USA (1961-62) and at the Michigan State University, East Lansing, Michigan, USA (1962-63). His Indian assignments have seen him as Lecturer and then Reader in Mechanical Engineering at- the Engineering College, Banaras Hindu University (1950- 58); as Associate Professor, Professor and then Professor and Head of the Department of Mechanical and Industrial Engineering at the University of Roorkee for nearly 20 years (1958-78), before he took charge as Director of the Indian Institute of Technology Kharagpur, in 1978. '

His score of academic attainments is both profuse and brilliant. He stood first in First Division in the Senior Cambridge School Examination from the Stewart School, Cuttack, Orissa, in 1938; passed his BSc (Engineering) with First Class Honours from the Banaras Hindu University in 1944; obtained the DIISc In Aeronautical Engineering with Distinction in Aerodynamics from the Indian Institute of Science Bangalore, in 1946; and qualified for his DIC in Aeronautics from the Imperial College, London, in 1947, and for MSc (Engineering) from the London University In 1949. Finally, he received his Ph D with major in Aeronautics and minor In Mathematics from the California Institute of Technology, Pasadena, USA. He has published many papers in national and international journals.

Professor Lal is an engineer with a truly multi-disciplinary background. His first engineering degree is in mechanical and electrical engineering. During this degree course he specialized in electronics and electrical communication engineering. His first professional Job was With All India Radio at Delhi. After his post-graduate education in England he underwent a course in aircraft navigation and passed the Flight Navigator's Licence examination. For his doctoral research he specialized in aeronautical engineering, and his primary fields of interest were fluid mechanics and heat transfer. On his return to India he worked at the Civil Aviation Training Centre at Allahabad, training navigators for the Indian Airlines and building up training facilities in navigation at the Centre. He was associated with the Civil Aviation Department of the Government of India for some years thereafter, in the licencing of civilian airline pilots.

As a keen promoter of the cause of engineering studies, Professor Lal is an active member of various learned and professional societies. He is a Fellow of the Institution of Engineers (India); a Fellow of the Academy of Sciences, Bangalore; and a Fellow of the Institution of Mechanical Engineers, London. He has been Vice-President of the Indian Society for Heat and Mass Transfer (1976-1981) and President of the Indian Society of Theoretical and Applied Mechanics (1981-1982).

Professor Lal has served on various committees in the field of engineering education and research. He has been a member of the Engineering Panel of the University Grants Commission (UGC);

member of the Science and Engineering Research Council (SERC) of the Department of Science and Technology; member of the Mechanical and Electrical Research Committee of the Central Board of Railway Research (BRR); and member of the Board of Governors of the Regional Engineering Colleges (RECs) at Allahabad and Srinagar. Currently he is Chairman of the Mechanical and' Electrical Research Committee of the Council of Scientific and Industrial Research (CSIR); Chairman of the Research Advisory Council and member of the Executive Committee of the Central Mechanical Engineering Research Institute (CMERI) at Durgapur; Chairman of the National Committee of the International Institute of Refrigeration (NCCIIR); member of the Eastern Regional Committee of the All India Council of Technical Education (AICTE); member of the Senate, Syndicate and Finance Committee of the University of Roorkee; and member of the governing bodies of several educational institutions such as the Regional Engineering College (REC) at Jaipur, the Technical Teachers Training Institute (TTTI) at Calcutta, the National Institute of Foundry and Forge Technology (NIFFT) at Ranchi, Vidyasagar University at Midnapore and the Indian Institute of Science (IISc) at Bangalore.

An eminent personality in the engineering profession, with profound dedication to the cause of progress and the advancement of his fellow engineers, Professor Shankar Lal brings a new dynamism to the Institution. His election is sure to make the profession stronger and enable it to contribute in more and better ways to the welfare of the nation. The profession fervently looks forward to his enlightend leadership, guidance and support in its continuing efforts to serve the nation.

Shri M D Patel
President 1983-84

Presidential Address

I stand here in all humility, honoured by my unanimous election as the President of the Institution of Engineers (India) for the current term. And even as I thank the members of the Council of the lnstitution, and through them the members of my profession throughout the country, for the great confidence they have reposed in me, I am deeply aware of my own shortcomings in shouldering the heavy responsibilities that go with this high office but I can assure you that I shall do my very best to prove worthy of your ohoice and work hard for the Institution and the ideals it stands for; and I feel certain that with the active assistance and continuing cooperation of my colleagues in the Council, I shall be able to serve the entire engineering fraternity of the country to their satisfaction.

As I address this distinguished assemblage on this the Sixty-Third Annual Convention of the Institution, I am moved by a sense of occasion. I am fully aware of the solemnity that attaches to these Annual Conventions : I know that they provide the fraternity with an opportunity for an examination of past performance and planning for the future; for a hard and close stock-taking and a renewal of faith in the days to come. If these Conventions are solemn occasions they are also joyous events which enable the profession to meet, exchange notes and thereby highten the awareness of our common ideals. And quite apart from thus, these Conventions are also a part of a transition process of the Institution where the orderly transfer of authority from one President to the next takes place.

I have today taken over the Presidentship from Prof Shankar Lal who has been one of the most dynamic Presidents of the Institution. During the brief one-year tenure of his office he has crossed several of the milestones he had promised he would in his Presidential Address last year. Norms for setting up Engineering Research, Design and Development Centres of the Institution (to be known as ERDDeC) as State Centre activities have been evolved. A clear cut policy regarding providing consultancy services, has been drawn up in that while members (or groups of members) of the Institution in their individual capacity may, indeed, provide consultancy services to industry, this should not be done as an Institutional activity. Hence the ERDDeCs will not undertake consultancy activities: but detailed guidelines are being drawn up for members who undertake this activity in their individual capacity.

Realizing that the Institution is growing fast, steps have been taken to formally decentralize some of the activities of the Institution. Thus, the National Design and Research Forum (NDRF) has been revitalized as an all-India activity with a new 14-member Steering Committee to guide its activities. NDRF will operate from Bangalore. The Engineering Staff College of India (ESCI) is rapidly taking shape. Its statutes have been finalized and continuing education courses are being run under its aegis. The ESCI is located at Hyderabad and I would like to avail this opportunity to publicly thank the Government of Andhra Pradesh for donating to the Institution 20 acres of land in Hyderabad for building the ESCI.

Perhaps the most significant advances have been made during the past year in the sphere of international activities. Bilateral agreements for cooperation have been signed with our counterpart Institutions in Yogoslavia and Bulgaria.

Arrangements for the 12th World Energy Conference, which is to be held in September 1983 in India, are progressing very well. Other large scale international conferences planned to be held in India under the sponsorship of the Institution are: the 12th World Mining Congress in November 1984; WFEO General Assembly in November 1985; and the Federation Internationale de la Precontrainte (FIP) in March 1986. In order to facilitate the organization of these international conferences, it is planned to build an International Secretariat of the Institution at New Delhi. The foundation of this Secretariat was laid by the Hon'ble Minister for Education and Culture, Shrimati Sheila Kaul on October 10, 1982. The activities of the Secretariat will be guided by the Council of the Institution.

The above are some of the many things you have achieved, Sir, during your tenure as President. You also brought honour to the Institution and to the country by your election as one of the Vice-Chairmen of the International Executive Council of the World Energy Conference for a two-year term. This is the first time an Indian has been given this honour.

Now keeping up with the tradition as I now exercise the privilege of addressing you as your new President, I cannot help being aware of the large, almost endless vista of purposive action that lies before us. As a professional person it would perhaps be quite in order for me to dwell at length on the particular field of engineering to which I belong.

Having had the begining of my career with the Public Works Department of the old Bombay State and now with the State of Gujarat, my experiences have been with vast fields of civil engineering — irrigation, water supply, ports, roads, bridges, buildings, etc —I chose to deal with the subject of transportation with which I have been intimately connected for over three decades.

GENERAL

The formulation of a correct approach to a national transport policy should appropriately begin with an examination of the broad social and economic background within which the transport system operates in a country and the socio-economic objectives and priorities it has to serve, so that development of the transport sector proceeds in close conformity with the needs of the economy.

Before independence, the transport system, comprising mainly railways and roads, was developed primarily to provide communications with the major ports and larger Cities, keeping in view the administrative, strategic and trade imperatives of that time. The focus changed after independence as, along with the rehabilitation of railways and reconstruction of highways, which were damaged or neglected during the Second World War, concern was simultaneously shown for the first time for rebuilding the transport network and linking it with developmental needs of the economy. Not only were programmes and projects formulated to extend the country's rail and road network but attention was given also to development of shipping, ports, air and other modes of transport. With the initiation of industrial development programmes, however, the main objective underlying the planning of the transport system was a systematic movement of raw materials to plant sites and of finished. products to points of consumption, particularly In respect of steel, power and heavy industry. Further, the needs of inter-city and urban passenger movement were brought into focus. A proportion of Investment was diverted to promotion of transport in the backward regions as a stimulus to their economic advancement.

The key role of transport in development of the national economy has been undoubtedly recognized since the inception of the First Plan but in determination of overall plan allocations it did not receive a matching priority with power or irrigation. In the face of financial constraints the approach to transport was generally towards creation of capacities mainly for moving specific categories of traffic for industrial projects and providing relief for passengers on congested urban networks. A comprehensive attempt to prepare a long-term transportation plan for the country as an integral part of the national macro-economic plan has still to be made. To develop and calibrate such a transportation planning model is admittedly a difficult and complex process, as it requires detailed data and analysis of regional trade flows and comparative resource costs of movement by various modes of transport. Such data on this scale are not presently available, although the Planning Commission has taken the initiative in filling the gap by entrusting a study on these lines to Rail India Technical and Economic Services Ltd (RITES). The Planning Commission has also constituted a Transport Policy Planning Project, the objective of which is to improve the forecasting methodology of transport demand in the country.

TRANSPORT DEMAND

As a service, transport, whether it is movement of goods or people, is a derived demand, for it is a means of serving other objectives and does not exist in isolation or for its own sake. Some of these objectives are economic in character; for example, exploitation of natural resources, increase in agricultural productivity and industrial output, enhancement of consumption levels, and diversification of the economy. Side by side with these objectives are those of a non-economic nature which include promotion of political cohesion, reinforcement of national security and encouragement to socially desirable settlement patterns. Further, economic and non-economic projectives are not always consistent; in fact, they are often incompatible. This throws up a serious dilemma for those engaged in developing an optimal transport system for the country.

Of the two basic components of transport demand, namely, freight and passenger traffic, the former is directly connected with the level of economic activity and development needs and has accordingly received greater attention in planning priorities. There is an assumption that so long as transport capacity is inadequate to meet the needs of freight traffic, it is not essential to provide for passenger services or personal travel. In our view, this assumption stems from a limited appreciation of the fact that a segment of passenger traffic, particularly journeys to and from work and business travel, is as essential to development and maximization of production as freight traffic. Besides, it is incorrect to lable non-work. passenger journeys as socially wasteful entitled to lower or no priority at all. In a developing country like India, most non-work travel undertaken by people in cities and on inter-city routes is linked with essential social needs, such as visits to families, educational institutions, religious centres and other similar purposes. It is thus not clear at what stage in the country's development, transport planners should accord the same priority to passenger travel as to freight transport. In the circumstances, as long as resource position remains as precarious as it is today, planners should continue to search for a balance between the needs of economic growth and those for amelioration of travelling conditions of general public. In the ultimate analysis, this depends upon the manner in which we define the scope of social welfare. In our view, passenger traffic situation has deteriorated due to relative neglect in the past, and it is time that a departure is made in transport policy to correct the present imbalance in our traffic structure.

Secondly, the transport system must concern itself with the needs of the rural sector which accounts for 80% of the Indian population. Out of 575936 villages in the country, as many as 407297 are still to be connected by all-weather roads. The Working Group on Rural Roads has calculated that to connect the villages with an all-weather road link within 1.6 km range of the road network, an investment of Rs 11000 crore in road construction would be required. In resource terms, this target will be difficult to achieve even if the planning horizons were extended over the next three Five-Year Plans or to 2000 AD. These figures underline the scale and magnitude of the task involved in construction of rural roads if the basic objectives of providing a minimum level of accessibility to our villages is to be achieved within a reasonable time span. No doubt, transport requirements for development of the nation's productive potential should continue to receive priority. But in the formulation of future transport policy which ensures internal consistency in development planning, attention must also be given to transport needs of the rural areas together with inter-urban and intra-urban passenger travel of an essential character.

GROWTH OF TRANSPORT

Despite sizeable expenditure, it is found that the transport sector capacity has continuously lagged behind requirements of the economy. The bulk of transport requirements have been met by railways and road transport, although other modes of transport, namely, civil aviation, coastal shipping, inland water transport and pipelines, also had a share in it.

RAILWAYS

With the addition of about 7 000 km of new lines since 1950-51, including restoration of dismantled lines, the rail network today extends over nearly 60 700 km, 30 900 broad gauge, 25 000 metre gauge and 4 300 narrow gauge lines. Of the railway route section, 47 900 km are single-line, nearly 12 300 km double-line and 450 km more than two lines. The running track kilometerage increased from 59 315 in 1950-51 to 75012 in 1977-78.

The growth of passenger as well as goods traffic on the railways has been much faster than of rail capacity. Between 1950-51 and 1977-78 the total passenger traffic increased from 66.5 to 177 billion passanger-km, and freight traffic from 44 to 163 billion tonne-km. Most of the traffic is concentrated in the quarter of rail network, which accounts for 75% of freight and 55% of passenger traffic.

The suburban rail services, concentrated mainly in the three metropolitan cities of Bombay, Calcutta and Madras, have multiplied as much as six times between 1950-51 and 1977-78, from 6.55 to 39.43 billion passenger-km. The growth of non-suburban traffic has been comparatively modest, having no more than doubled, from 59.97 to 137.27 billion passenger km in these years.

ROADS AND ROAD TRANSPORT

Next to railways, road transport plays a key role in the country's transport system. It provides the only means of mechanized transport in hilly, rural and backward areas which are not connected by rail. Road development plans have broadly followed the approach of the Nagpur Road Plan in the post-war reconstruction phase and under the First and Second Plans, and the Bombay Road Plan for 1961-81. The latter Plan envisaged that road length in the country would increase from 3.79 lakh miles (6.09 lakh km) in 1961, to 6.57 lakh miles (10.51 lakh km) in 1981, of which 40% would be surfaced.

The total road length in the country increased between 1950-51 and 1975-76 from 3.98 to 13.84 lakh km. The total road length in 1975-76 included 28870 km of national highways and 97700 km of state highways, the balance comprising district, village or rural, urban, project roads, etc. About 5.46 lakh km, or nearly 39% of total road length, in 1975-76, constituted surfaced road length.

The development of rural roads was given priority in the Fifth Plan when a specific outlay was provided for it under the Minimum Needs Programme. It was then proposed that a link road should be provided to all villages with a population of 1500 or above. The position as at the end of 1977-78 has been explained elsewhere. As against a total number of 5.76 lakh villages in the country, about 29% only had all weather roads and 16% fair weather road connections as on March 31, 1978. The number of villages which remain to be connected with any road is 3.14 lakh and those with an all-weather road is over 4 lakh ; 84% of which fall in the category of those with less than 1000 population.

The total number of motor vehicles registered a tenfold rise in the country, from 3.06 lakh in 1950-51 to 32.36 lakh vehicles in 1977-78. Of these, two wheelers and three-wheelers have increased from about 27000 in 1950-51 to about 15 lakh in 1977-78. The number of buses increased from 34411 to 117449 and trucks by a still higher figure from 81888 to 368193 in these years. Out of 117449 buses registered in the country 58128, or, 49.5% of the total strength are owned by the public sector road transport undertakings and the remaining 59321, or, 50.5% by the private sector. The ownership of trucks is almost entirely with the private sector, the nationalized sector accounting for only 1827 trucks or 0.5% of total truck fleet registered in 1977-78.

Precise data on the traffic served by road transport, particularly by trucks, is not available. It is however, estimated that the passenger traffic by road has increased from 23 to 250 billion passenger-km, between 1950-51 and 1977-78. Similarly, freight traffic by road is estimated to have increased from 5.5 to 77 billion tonne-km in this period.

INLAND WATER TRANSPORT

India's navigable inland waterways extend over nearly 14500 km and comprise a variety of river systems, canals, backwaters, creeks and tidal inlets. The navigable length of important river systems in the country is about 8973 km, of which only 2498 km are navigable by steamers. Andhra Pradesh, Assam, Bihar, Kera1a end Uttar Pradesh offer relatively greater potential for development of the inland water transport (IWT) system. Most of the waterways, however, suffer from navigation handicaps like shallow water and narrow width during dry weather, siltation and bank erosion. Because of these constraints, only about 5 200 kms, or, half the river length of the major rivers, and 485 km of canals are suitable for mechanized crafts. No accurate estimate of traffic carried by IWT system is available. However, Goa accounts for the largest proportion of total originating traffic, the bulk of which consists of iron ore. Traffic in Kerala consists mostly of clay and sand, coir, bricks, tiles and fertilizers.

COASTAL SHIPPING

India has a long coastline of 5660 km. It has 178 ports, 10 of them being major ports and 168 minor ports, including 23 intermediate ports. Coastal shipping has stagnated, however, and the traffic handled between 1951-78 declined progressively.

The total coastal shipping tonnage increased between 1951-76, from 2.17 to 4.42 lakh GRT but declined thereafter to 4.00 lakh GRT in 1978. The reduction occurred mainly on account of a substantial fall in the number of dry cargo vessels. Whatever increase in GRT that had occurred was due to increase in the number and size of oil tankers. The total volume of traffic carried by coastal shipping increased between 1951-62 from 25.2 to 64.2 lakh tonnes (41.0 lakh tonnes of dry cargo and 23.2 lakh tonnes of wet cargo) but thereafter it progressively declined, reaching a level of 37.4 lakh tonnes (15.5 lakh tonnes of dry cargo and 21.9 lakh tonnes of wet cargo) in 1975. Figures for the subsequent period are available only in respect of dry cargo, the coastal movement of which declined further to 10.9 lakh tonnes in 1978. The main items of dry cargo handled by shipping are coal and salt.

AIR TRANSPORT

Domestic air services operated by the Indian Airlines after nationalization in August 1953 registered a spectacular expansion over the last two decades. The main business of Indian Airlines is passenger traffice, the number flown having increased from 0.79 to 4.37 millions between 1960-61 to 1977-78. In terms of revenue passenger kilometres (RP km) traffic has increased from 624 million RT km in 1960-61 to 3389 million RT km in 1977-78. In terms of revenue tonne km (RT km) covering passengers, cargo, mail and charters, traffic has increased from 83.20 million RT km to 324.96 million RT km in 1960-61 and 1977-78.

Domestic air traffic has been continuously increasing at a rate of around 12-15% each year. In fact, in the last two years the growth rate was even higher, 16% in 1977-78 and 20% in 1978-79. Most of the traffic is concentrated in trunk routes which account for 65% of the total traffic. Other busy operational sectors are the North-East, Bombay-West coast and the Saurashtra regions where the demand for air transport has increased since the surface modes of transport are not adequately developed.

Indian Airlines has increased its capacity from 113 million available tonne km (AT km) in 1960-61 to 481 million AT km in 1977-78. In available, seat km (AS km). the capacity increased from 864 mlllion AS km in 1960-61 to 4806 AS km in 1977-78. Over the years, the fleet mix of Indian Airlines has undergone a major change. Piston engine aircraft have been phased out and now low capacity turboprop aircraft are being replaced by high capacity jet aircraft. Accordingly, the total number of aircraft has declined from 99 in 1953-64 to 48 in 1977-78. About 85% of available seat km today are provided by Boeing 737 and Air Bus (AB-300).

TRENDS IN TRAFFIC

A significant development in the transport sector is the marked shift in the relative share of rail and road transport in total traffic carried during this period. The share of road transport in both passenger and goods traffic increased at a much faster rate than of railways, although in absolute terms traffic increased substantially on both modes of transport.

The share of rail and road transport has been generally in the ratio of 67:33 for freight and 40:60 for passenger transport.

TRENDS IN GOODS TRANSPORT

The growth of freight traffic, however, tapered off during the last decade, with freight traffic growing at the same rate as national income.

The bulk of freight traffic carried by rail comprises mostly goods like coal, iron and steel, cement, fertilizers and petroleum products, the proportion of which has increased from 55% to around 8G% of total rail freight traffic in 1950-51 and 1977-78. The traffic in general goods has remained more or less stationary, fluctuating between 45 and 50 million tonnes in the period 1960-61 to 1977-78.

Not only has the volume of originating traffic carried by rail undergone a sharp increase; the average lead of freight traffic by rail has also risen considerably. For example, the average lead which was 470 km in 1950-51 increased to 686 km in 1977-78.

TRENDS IN PASSENGER TRANSPORT

Two modes of transport — rail and road — account for most of passenger traffic. Air transport also provides an effective alternative for long distance traffic, although it constitutes a relatively small proportion of total passenger kilometers moved in the country. A large percentage of traffic carried by air transport over longer hauls is accounted for by pairs of points like Delhi-Bombay, Calcutta-Delhi, Bombay-Bangalore and Madras-Delhi. The rate of growth of passenger traffic has been much higher than growth rates of population and national income.

IMBALANCES IN THE TRANSPORT SYSTEM

Despite continuous efforts made since 1951 to augment the capacity of various modes of transport, the transport sector has generally experienced bottleknecks and capacity shortages. The imbalance between demand and supply of transport facilities has already affected the smooth functioning of the economy. During the last decade, in particular, the growth of transport capacity lagged behind requirements of the economy, so much so that difficulties and problems arose in almost every part of the country in regard to movement of essential commoditeis needed for industrial and agricultural development and for meeting consumer needs of the community.

The burden of transport has been naturally borne by railways which recorded a four-fold increase in freight traffic without commensurate investment in rolling stock or line haul capacity, resulting in bottlenecks, a major issue in transport planning policy. The most difficult problems faced by railways were in relation to movement of commodities like coal from Bengal-Bihar coalfields, foodgrains from northern India to destinations in southern and eastern India and cement from southern to northern India. These difficulties were experienced particularly during the last decade, one of the causes being the changed pattern of freight movement by rail. For example, when foodgrains were being imported, traffic flow in this commodity was from ports to consuming States in the northern and eastern parts of the country. With self-sufficiency in foodgrains, the traffic pattern has changed, foodgrains now move from northern States to destinations in the southern and eastern regions. Similarly, the decision to import cement also placed additional strain on railways for transporting this commodity from ports to consuming centres in the north. Had there been sufficient resilience in the railway system, these unforeseen, shifts in traffic pattern could have been handled without creation of any bottlenecks. Apart from pressure on railways on account of sudden shift in the traffic pattern, the rail system had also to cope from time to time with dislocations caused by floods and other natural calamities. Some resilience in the system is necessary to deal with such unforeseen occurrences. The rail system has also been under pressure for movement of passenger traffic, particularly on long distance and suburban routes, notwithstanding addition of number of new trains.

TRANSPORT AND ECONOMIC DEVELOPMENT

That economic development requires adequate and effective transport services is axiomatic. That there exists, for a given country at a specified stage of development, a theoretically optimum amount of transport capacity is also generally accepted. Nonetheless, any agreement on determination of these capacities and implied rate of investment is far from unanimous.

Contemporary opinion on the role of transport in economic development falls broadly into two divergent schools of thought. There is a school which maintains that development of social overheads, including transport, should precede growth of other economic activities and hence investment in social overheads should be made in anticipation of future demand, instead of as a sequel to capacity shortages. The rationale underlying this argument is that once social overhead capacities are created they generate a variety of external economies which reduce the cost of inputs used by other economic activities. This serves as a powerful Stimulus for exploiting unutilized and under-utilized resources which would otherwise have remained unused for want of infrastructural facilities. The other school of tought holds opposite view and argues that transport and other infrastructural facilities should be built only in response to bottlenecks and capacity shortages, not in anticipation of demand that may not, after all, materialise. The justification for this view is two-fold the risk and uncertainty associated with long-term investments and the general belief that investments on the large scale generally required for development of social overheads are not easy to plan.

During our visits to various States, we were faced with persistent demands for investment in capital intensive transport projects, particularly, new railway lines, on the ground that this would promote development of the under-developed areas. We have given serious thought to the question of whether transport investment is really an essential pre-requisite for economic development, or it should follow development of other economic activities which generate adequate demand for transport services. Endowing an area with a highway or a railhead will not by itself result in an upsurge of new industrial or agricultural activity. Apparently, expansion of transport is permissive; it enables a dynamic developing situation to work its way and can reinforce existing motivations. The degree to which transport creates or compels new activity will depend upon other equally necessary conditions within the economy, such as the quality of its administrative structure and social order, the level and quality of education, the zeal and drive of its entrepreneurial class, and other dimensions of the people's prospensity to grow. If these qualities are deficient, transport investment is unlikely to start the process of self-propelling growth.

INADEQUACY OF TRANSPORT—A DETERRENT TO GROWTH

While, therefore, we do not subscribe to the view that transport investment will by itself bring about economic up lift of backward areas, we, at the same time, consider it necessary to emphasize that inadequacy of transportation acts as an inhibiting factor in the actual process of development. As development planning has an integral part of the economic way of our life, the chicken-or-egg-first argument for transport is of academic interest. As we have stated, construction of a new railway line or a road in a less developed part of the country will not automatically bring about an economic transformation of the region. But if construction of such a facility forms an integral part of development plan for the region and selection of the project is based on comparative cost-analysis of different modes of transport, its construction prima facie will be an essential pre-condition without which development of the region will hamper. In such a case, any delay in construction for the service builds up is like putting the cart before the horse. Indeed, in planned development, where differnet sectors of the economy are expected to grow in close coordination, transport is only one of the essential elements of an integrated plan for area development.

TRANSPORT CAPACITY IN ANTICIPATION OF DEMAND

The case of creation of transport capacities in anticipation of future demand rests logically on two stronger considerations. Firstly, transport like power is anon-traded commodity, that is, its services cannot be imported; transport investment is lumpy in character. It is, therefore, necessary to allocate funds for creating transport capacity even if the demand for its service does not justify investment on the basis of its commercial viability. Secondly, the lumpiness of investment also makes it necessary to create capacities on a scale larger than is justifiable in relation to immediate demand if we are to benefit from economies of scale associated with a transport plan. Thus, for example, once the need for railway investment is established, at least a single track must be constructed along with the concomitant linehaul and terminal facilities for the benefits to accrue. Similarly, a road with a sufficient width must be built between two points before it has any utility.

SIZE OF TRANSPORT INVESTMENT

The three central issues to be considered in evolving an integrated framework for transport policy are:

(i) determination of the size of total transport investment, that is, quantum of resources — capital, foreign exchange, scarce materials, and manpower — which should be devoted to development of the transport sector as a whole;

(ii) distribution of these resources between various modes of transport ; and

(iii) tariff for transport services, taking into account the return on investment made thereon.

NEED FOR INCREASED FINANCIAL ALLOCATIONS

The question of total quantum of resources to be invested in transport development is, in a sense, related to the role of transport in economic development. Our assumptions regarding technical indivisibility of transport and the consequent need for creating capacities ahead of market demand are equally applicable in the present context. The allocation of funds to the transport sector has perforce to be larger than to those sectors where the incidence of lumpiness is not so heavy. It may, however, be argued that if a country's macro-economic plan is based on an inter-sectoral input-output model, as is the case in India, and if sectoral forecasts produced by this model are accurate and reliable, there could hardly be any logical reason for denying adequate investment funds to transport vis-a-vis other sectors. All the same technical considerations, namely, that it takes a fairly long time to build transport capacities, and that, except for building of village roads, construction of most line-haul and terminal facilities must be undertaken in large units, imply that more resources are required for transport than is indicated in input-output consistency models. These considerations are powerful arguments In our view, for including transport in the priority sector for determination of inter se priorities for the plan.

It must, however, be conceded that lumpiness is not a feature peculiar to the transport sector alone. Nor are the gestation lags of other sectors any the less important. Wherever such technical characteristics are applicable, the same criteria must more or less prevail in determination of *inter se* priorities.

TRANSPORT INVESTMENT AND ECONOMIC GROWTH

Another important factor to consider is whether there is any evidence of an empirical relationship between transport investment and rate of growth of national output. The proportion of gross capital formation in transport to gross domestic product ranges from 0.99% to 2.84% in the period 1951-52 to 1976-77. However, these percentages do no indicate any casual relationship between the rate of capacity created in transport and of growth of national output. If it is correct to postulate that there is such a casual relationship, it must be tested by empirical evidence. We have attempted this and we find that there is significant correlation between transport capacity and growth rate in India. Studies undertaken for other developing countries, for example, Kenya and Venezuela, among others, also confirm a close correlation between capacity creation in transport and growth of GNP.

As there is also a critical rate at which net capacity should be created in transport each year to maintain total transport capacity at its optimal level, the planning authorities have to examine these relationships systematically, so that the total resources for transport development are adequate all the time. It is, however, not possible to specify a precise or fixed figure at which the share of transport in the total national or public sector outlay should be maintained in every

Five-Year Plan.

What we are here seriously concerned with is the progressive decline in the share of transport in total plan outlay, and we feel that if this trend continues it could severely damage our national economy. Presently, our major ports, most of our airports and the major trunk routes of our highways and railways, are all operating under severe pressure due to capacity shortages. True, a part of the current shortages is of a temporary nature, as they have arisen from unexpected changes in traffic pattern of the country. Nor are all the agencies or networks of the transport system operating at optimum levels. But the fact remains that there is presently hardly any resilience in our transport system to enable it to cope with sudden and unforeseen demands on it.

We attach the greatest importance to the need for maximum economic use of all available capacities in the transport system wherever they exist, but we do not subscribe to the view that during the planning period since 1951 any mode of transport had received a disproportionate share of public funds for investment and had consequently developed surplus capacities.

INVESTMENT POLICY AND INTER-MODAL MIX

The central issue of investment policy is to allocate total resources assigned for transport development between agencies of transport system to meet transport needs of the economy at minimum cost to the society. The crux of the problem thus is to determine an optimal inter-modal mix in the context of dynamic growth and board criteria for allocations between agencies of the transport system.

A number of general propositions may be made on this subject. First, in framing an integrate approach to transport policy, it is useful to view the inter-modal mix from a system's point of view, that is, a system In which modes of transport complement, rather than substitute each other, each mode performing a job for which it is best suited on the basis of its comparative resource cost advantage. The central question here Is the method we should adopt to measure the comparative cost advantage of agencies of transport. We also have to consider what element should be included in or excluded from that measurement, so that there is a fair approximation of what may be called 'resources cost to the economy'. The comparative resources cost of various modes of transport cannot, in principle, be correctly computed unless a rough idea is formed of the volume and composition of future traffic. It is, therefore, necessary to formulate estimates of future traffic demand at the macro-economic level for a realistic determination of comparative modal costs and projected traffic flows allocated between different modes.

The primary purpose of obtaining such traffic forecasts is to provide a perspective on growth rather than a rigid frame. The traffic forecasts and their inter-modal flows should be computed for a fairly long time-horizon, from 10 to 15 years, say, in conformity with longevity of life of most transport assets, Finally, we Have to consider what shadow prices to adopt for energy and other scarce inputs used by the transport industry. Foreign exchange being always scarce, we have to see how best we can and should use it by putting a shadow price on oil, the import of which accounts for a substantial part of our foreign exchange payments. The question of putting shadow prices on scarce inputs raises many related questions. The crucial question is how far and to what extent market prices, affecting consumer behaviour, should influence the policy, considerations of planners for transport investment decisions; or to what extent social costs like that of congestion, pollution, and ecological imbalances should weight with the planners, to avoid any distortions consumer behaviour may introduce in the economic system.

PRICING POLICY

This brings up to the pricing and subsidy policy in transport. The first basic principle for pricing is that it must be cost-based, the user to pay at least the full marginal resources cost of his transport. The shortrun marginal cost is the minimum price the user should in any case pay; any mark-up above the figure is in effect in the nature of contribution from users to capital cost.

Once a facility is created and capital utilized, what rate of return a transport undertaking should earn on it essentially depends on the quantum of resources mobilization by the Government. The Government may wish to ensure as a matter of policy that capital earns a rate of return in transport generally corresponding to its scarcity value in the economy. But depending on demand elasticity for the service, the Government may aim at earning a higher rate of return on a particular investment in transport. The more inelastic the demand, the greater is the opportunity for generating resources by charging prices above the short-run marginal cost. While the extent of actual mark-up above short-run operating costs is thus a matter of resources mobilisation policity and demand elasticity, a rational pricing policy should ensure that in no case could transport tariffs be lower than shortrun operating costs. In a planned economy, another sound pricing principle is collection of revenue by a transport undertaking above the minimum level required to cover its short-run operating costs, including maintenance, the additional revenue to accrue to th. exchequer as part of a national pool of resources. The transport undertakings can draw upon this pool for their normal requirements covering replacement, modernization and capacity expansion in accordance with inter se investment priorities determined by the Government on broad premises of economic development.

ENERGY AND TRANSPORT POLICY

We are concerned about our heavy dependence in transport on petroleum products-a non-renewable resource. Transport consumes nearly one-third of the country's oil and a substantial portion of diesel supplies. It is sometimes argued that the real resource constraint in determining an optimal inter-modal mix for the future should not be availability of monetary funds as shortages of oil supplies. Accordingly, it is suggested that the use of private cars and lorries should be discouraged and railways encouraged for energy conservation. There is no doubt that energy conservation will be the most important guiding principle in the framework for determining an optimal mix of our future transport system.

ENVIRONMENTAL OBJECTIVES

Finally, in framing a Icing-term transport policy for the country, we should not ignore the adverse impact of transport on environment. In India there is general lack of concern about environmental implications in regard to growth of transport, especially of road traffic. The problem is acute in our cities where travelling vehicles is acute in our cities where travelling vehicles generate noise, fumes and often hideous visual intrusions, and result in accidents, personal stress and physical damage to the fabric of urban society. There heavy lorries use approach roads or roads In residential areas, conditions worsen for the people.

Much can be done to mitigate these nuisances. For example, appropriate regulations on lorry size and weight, noise and fumes can be an effective protection against environmental pollution. Similarly, sound traffic management and parking policies can reduce traffic congestion in the urban areas and bring about significant environmental gains. Effective land use policies, which may promote desirable shifts in population and employment, can -also Improve the quality of urban environment. On our inter-city routes there is also a great opportunity for Improving the quality of environment by planting trees and providing adequate wayside amenities. We urge upon the authorities, especially the State Governments and local bodies, to devise schemes for safeguarding. the environment both on urban and inter-urban routes and integrate them with planning for development of a future national transport system.

ENGINEERS—INDISPENSABLE IN ANY DEVELOPMENT

Included in our Institution's membership are the engineers and surveyors to almost all the transportation authorities as well as the larger and smaller highway authorities in the country. Much of the work of these engineers concerns transportation, highways, traffic engineering and other aspects of transportation. Many of the country planning officers are also our members. So are virtually all the engineers to the largesize district councils, who are generally responsible for planning as well as for other technical services of their authorities. An increasing number of members are also being taken in for directing and coordinating posts covering groups of technical services, including transportation and planning. The profession and the Institution can therefore rightfully claim that they can cater well for all the technology and manpower needs to have a large coordinating role in tackling the country's transportation problems.

For its part, the Institution has been playing a prominent part in the developmental activities of the nation by offering the right forum to attract creative thoughts and talents together thus bridging the existing gaps in knowledge and catalyzing actions to further the country's progress.

In this background, the Institution has been continuously readjusting its activities in keeping with current trends to ensure the appropriate recognition of matters of national concern — ecological, conservation and aesthetic values — in the development of public works and services. The human dimension has been receiving the utmost attention in all its new and re-vitalized professional committees and programmes. The leadership of the Institution has fully recognized and extensively commutted itself to the need for regular discussions on energy transportation, materials, water resources, land use, rural development, public health, ecology, pollution abatement, etc — all vital aspects that influence the quality of life. In these contexts, it is in a pre-eminent position to communicate more effectively with the members and through their increased collective participation, pool and disseminate knowledge which will assist national development in terms of transportation.

Closer involvement of the Institution at the national policy-making level could ensure smoother flow of information from the ministries to the State authorities concerned on all technical and technological matters for which engineering professionals alone are responsible. In turn, this will lead to wider accessibility to expert knowledge and in consequence to the maximum utilization of indigenous resources. This endeavour to improve the Institution-Government communication both internally and externally should receive priority considerations. It should be coupled with efforts from both sides to focus attention on the community's ever-continuing techno-social needs, self-rejuvenate the country's engineering and utilize to maximum effort the enlightened advice and guidance from professional specialists for tackling the transportation problems.

I have no doubt that the enlightened Government will take full note of the availability of highly qualified engineers within the profession as well as their ever preparedness to serve the nation selflessly in all contexts where engineering and technology hold the key. I look forward to the Centre and the States as' well as all those concerned with development of the people to enhance the nation's prosperity through greater and more coordinated engineer effort which is the foremost need in our present context .

Before I conclude this Address, I wish to express my grateful thanks to our honoured Chief Guest, Prof Satish Dhawan, who has so kindly responded to the invitation extended by the Institution and graced this occasion, notwithstanding his preoccupations and the pressure on his precious time. I do not have to go into the details of what, Prof Dhawan has achieved for India in terms of space technology, for his remarkable contributions are already so well known through out the world. There is no gainsaying that within a short span of time that was available to him Prof Dhawan has not only given a tremendous fillip to the progress of space R & 0 in India but by personal involvement has helped it immensely to develop indigenous technology and the required manpower to tackle the stupendous work involved in the space mission which the country has set for itself. Naturally all of us here are eagerly expecting to hear him describe, at least in outline the momentous work that he and his trusted colleagues shared to add a new height to Indian technology as a whole, bring it many laurels and raise India's image high up in the 'Space Nations' of the world today. Therefore, without dialating further, I would also like to express my immense thanks to the many distinguished colleagues of the engineering fraternity who have heard me speak so patiently on one of the crucial problems facing the nation. I have no doubt that they fully appreciate the enormity of the problems transportation poses and share my views that an enhancement of the engineering profession- Government inter-relationship is most vital to ensure more efficient performances in the context of our schemes for national development, among which transportation is just one key issue. I wish to assure them again that, as their new President, it will always be my earnest endeavour to share their thoughts .and work at all times with them in the greater interest of the people at large.

Thank you.

Shri M D Patel—a Brief Profile

Shri M D Patel, FIE, a civil engineer with acknowledged academic attainments and years of professional practice marked by distinguished engineering achievements and significant contributions, has been unanimously elected as President of the Institution of Engineers (India) for the Session 1983-84. He will take office from Dr Shankar Lal, FIE, the retiring President, at the 63rd Annual Convention-of the Institution in January 1983 at Madras when the Tamil Nadu State Centre will also celebrate its Diamond Jubilee. Shri Patel is presently Secretary to the Government of Gujarat, Building and Communications Department, Gandhinagar.

Shri Patel has given a large measure of his professional life to the Institution. As a staunch champion of the cause of the engineering profession vis-a-vis development of the Institution, the significant services and contributions of Shri Patel are already so well-known that they hardly need any repetition. As an ardent advocate of these, Shri Patel has actively served the professional engineering fraternity for well over two decades holding several honorary offices both at the State and All-India levels. He has been a member of various Committees of the Gujarat State Centre and Chairman of the Centre, a member of several of committees of the Council and a member of the Council for a number of years. Currently, he is Chairman of the Civil Engineering Division of the Institution.

His dedicated and strenuous efforts immeasurably helped the Gujarat State Centre not only to revitalize its technical activities in consonance with advancing technology and local needs but to progress its building project considerably. Identifying himself with the aims and aspirations of the community, he gave a unique lead to the State Centre and others concerned to intimately involve themselves and vigorously pursue a variety of developmental programmes such as giving free technical assistance to rural areas, establishment of consultancy cells, organizing extension learning programmes for the benefit of professional engineers, rejuvenating and encouraging young engineers to associate themselves with senior members, and so on.

Shri Patel has had a brilliant academic career with many impressive records. After passing the matriculation examination of the Bombay University with distinction, he had his science education in"the Gujarat College at Ahmedabad from where he secured first places in both the. first year and intermediate examinations of the Bombay University. He then entered the Poona Engineering College choosing civil engineering as his discipline and with outstanding successes throughout the course of his studies, he obtained a First Class First with Distinction in the final degree examination, securing the First Rank in the Bombay University.

Continuing his engineering education further, he proceeded to France where he undertook advanced learning and training programmes of ACTIM in bridge engineering and port development. He next took up intense studies in the field of prestressed concrete engineering and also studies pertaining to ferry services between Europe and the United Kingdom. Apart from these, Shri Patel had the opportunity of special study assignments related to modernization in housing programmes in Canada under the Colombo Plan. During these assignments, he made extensive studies on: a variety of large size housing projects in Canada; the complexities in the development of new townships; innovative approaches in the field of building materials technology; and manufacture of building materials in factories.

Commencing his professional career in the Select Services Cadre in the PWD of the then Bombay State as Assistant Engineer (Class I) in 1948, Shri Patel subsequently rose to the positions of Superintending Engineer in 1961, Chief Engineer and Joint Secretary in the PWD in 1967, Special Secretary to the Government of Gujarat in 1971 and Secretary in complete charge of the PWD of the Government of Gujarat in 1975. In this present position as Secretary to PWD, Shri Patel is also the Chairman of the Gujarat State Construction Corporation in addition to being the Secretary to the Government, Building and Communications Department, presently.

Besides these, Shri Patel is also associated as Director of many public undertakings such as the Narmada Cement Ltd, Dahej-Ghogha Ferry Services Ltd, Gujarat Industrial Development Corporation, Gujarat Housing Board, etc.

Through his pioneering studies, intimate personal involvement and dedicated work, Shri Patel has made remarkable contributions to help development of the Gandhinagar Town ship complex, the

State Capital of Gujarat, with which he was in charge as Chief Engineer right from the inception of the plan 15 years before. As an eloquent testimony to the extensive work he undertook in this context and the whole gamut of activities he so ably led and managed mobilizing all the needed vital resources, it is on record that his qualities of dynamic leadership and extraordinary organational ability enabled the Government of Gujarat to shift its Secretariat from Ahmedabad to Gandhinagar within as short a span as 36 months. Similar to Chandigarh, Gandhinagat stands today as a picturesque site yet another unique achievement in the art of township building commanding elegant office complexes as well as a quite and peaceful environment wherein housing complexes with skylines of pleasing architecture have sprung up integrating the overall beauty that is Gandhinagar.

Shri Patel's invaluable services have brought for him many laurels — not only in the State of Gujarat but at the national level as well. In recognition of his distinguished accomplishments where he has shared his profound knowledge and vast experience for the benefit of others the Indian Roads Congress (IRC) honoured him by electing him as their President. He was Vice-President of the IRC for several terms and has been on its Council and many of its important committees for a number of years. He was a member of the IRC Highway Research Board. He was one of the nominees of the Government of India who represented the country at the International Roads Congress held at Mexico in 1978.

Shri Patel is also closely associated with numerous academic institutions and their governing boards and as a member of many university panels. Apart from being a member of the Managing Committee of the Indian National Group of the International Association of Bridge and Structural Engineering, he was a member of its Permanent Committee. Shri Patel has Widely travelled on professional and various other assignments.

The unopposed election by a large plurality brings to us a multifaceted personality — conscientious, persuasive, devoted and selfless — in Shri Patel through whose wisdom and dynamic guidance the Institution and the profession are eager to seek, hopefully, a greater role and a period of further advance towards the future. To help him fulfil his mission is the responsibility of each of us. We re-affirm to continue to give him our best.

Shri S K Mukherjee
President 1984-85

Presidential Address

I am grateful to the Council of the Institution for the honour they have .extended to me by electing me unanimously as their President for the current term. I accept it in all humility. I consider this is a unique instance because this will be, perhaps, the first time in recent years that a Member of an emerging engineering discipline, namely, the Chemical Engineering, has been chosen to lead this august body of ours. This is a glaring proof of how the Institution — which fosters a federation of multiple engineering disciplines — is striving to give equal importance and weightage to all disciplines no matter whether they are developed or developing or new and emerging. In this sense, it would be very appropriate to liken the Institution to a chariot which is being piloted towards one major goal, namely, the path of technological progress, by galloping horses in terms of its several widening disciplines. Naturally, failure of anyone horse would thwart the overall movement of the chariot as a whole. I have no doubt that our close bonds and united efforts will take us on further from strength to strength in the years to come as it has been in the past 63 years of the Institutions glorious existence.

I am very well aware of the tremendous responsibilities which will rest on me in this high office in the contexts of the Institution's dynamic spread and innate interests and involvement in advancements at the national level as well as its much — sought for leadership in the sphere of international activities. All the same, I am most confident that I can always count upon the goodwill, wholehearted cooperation, enthusiastic support and enlightened guidance of the Members of the Council as well as the members of the engineering fraternity as a whole to help me elevate our profession and the image of the Institution even more notwithstanding the ever increasing challenges that are swiftly overtaking all our efforts. As you may recall, the Institution has already made a great headway in its bilateral and international activities in close cooperation with several professional societies and international bodies the world over. You have already witnessed the unique success of the 12th Congress of the World Energy Conference — the first largest to be held in a developing country like ours — which our Institution hosted at Delhi in September 1983. The Institution's International commitments, as we stand today, are even further. It is already hectically working to host the 12th World Mining Congress at Delhi in November this year — marking the first of its type being organized again in a developing country. It is also simultaneously progressing work at various levels to successfully conduct the Second World Environmental Congress in 1985, the 10th World FIP Congress in 1986, and the UNESCO cosponsored World Continuing Education Congress in 1988.

Having given a glimpse of the Institution's vast arena of professional dedication, I feel duty-bound on this momentous occasion to convey, on behalf of all of us, our sincere regards and thanks to the retiring President, Shri M D Patel. A personality commanding such excellences of head and heart as Shri Patel is rather difficult to find. As your distinguished President for the Session 1983-84 giving his time and energy so selflessly, Shri Patel was responsible to raise the Institution to a loftier horizon both nationally and internationally. I would, on my own behalf, like to re-assure him that I shall with pleasure share his precious thoughts and strive to the utmost to maintain the high standards he has already set for furthering the frontiers of the Institution's professional and learned activities both at home and abroad.

Today we are indeed very fortunate to have amidst us our respected Chief Guest who has honoured us with his presence to bless us through our deliberations. We are immensely grateful to you Sir, for having given us this moment of exhilarating joy, sparing your precious and pressing time for our sake. We are also equally thankful to the several dignitaries, friends and well-wishers who, despite their pre-occupations, have come here to participate in the Convention. The presence of so many distinguished personalities here is a positive indication of the love and affection they all bear for the profession we are committed to. On behalf of the National Council and members of the Institution and on my own behalf, I wish to convey our gratitudes to them all. I would also like to thank our Past-Presidents, honoured Guests and Members of the Institution who have come here from all corners of the country, for their inspiring presence. We have also with us here a few distinguished visitors from overseas who have very kindly responded to our invitation. On behalf of you all, I welcome them heartily and offer our hearty greetings and very best wishes. I hope they will enjoy our hospitality and a comfortable stay and go back to their sweet homes with pleasant memories.

As is customary to the Annual Convention, the in-coming President is expected to present his views in a Presidential Address having relevance to the technical and professional obligations of the Institution vis-a-vis the prosperity and welfare of the nation. In fulfilling this task, I would like to slightly deviate from the traditional form of Address, with an objective desire to placing before you some national issues of current interest and high priority - with special emphasis on the 'Technology Policy' for the country announced by our Prime Minister some time ago.

OUR NATIONAL 'TECHNOLOGY POLICY'

We, are in the midst of Sixth Five-Year Plan and have already commenced exercises for the Seventh Plan. As responsible members of the society, we engineers are one of the main agents who translate plans into practical actions. Our Institution and the profession alike are deeply concerned with the developmental activities of the nation; and as such, we are interested and closely involved in the technology Policy statement and the resources to implement it. If one may recall, it was a long way back, in 1958 or so, that the Government formulated the 'Science Policy' and it has been almost 25 years later that the 'Technology Policy' has been announced. We are all aware that both these policy statements relate to plans of action needed in the industrial, agricultural and service sectors, their main objective being to ensure that the benefits of development percolate to the weakest members of the society — predominantly the rural poor. No doubt, even as of today, our country has progressed enormously well in some specific sectors; and yet much has to be accomplished in terms of food, nutrition and health for the masses. Although we engineers and technocrats have a major role in the country's planning process, our involvement is sought by the planners even today only to the extent that we become responsible to create wealth by transforming the, natural resources into industrial products and services. Thereafter, it is the administration and the statesman that take on as the main agencies to distribute the wealth so created and ensure sufficient reserves for future growth. My suggestion is that even in the act of distribution of wealth the technocrats should have some say not because they create the wealth which is their bounden duty to do-but because they can ensure the balanced way of technological development for creating wealth for the future.

At the Cochin meeting in December 1983, the Council of the Institution gave a deep thought to our New Technology Policy and after detailed discussion, the members unanimously expressed the view that implementation of the Policy should be very carefully handled and, if mis-applied, it would spring back and shatter the very basis of actions towards self reliance. Following the deliberations, the Council also took a decision that as on the memorable Engineers' Day which we celebrate on 15th September every year a national forum should discuss matters of engineering and social interest vis-a-vis the 'Technology Policy' statement. It is in this background that it approved the National Seminar on 'Science and Technology for Rural Development' as a major feature of the 64th Annual Convention being held here during the next three days.

As a Chemical Engineer involved in R&D activities for a long time — specially in the design engineering field, I may well comment on some of the points contained in the Technology Policy. It may be noted here that my observations have not been propounded on classical theory but based on hard realities. In my deliberation, I would like to present some case studies on 'industry' which also includes 'agriculture', the main agency by which the country should create wealth.

A DISTRESSING SITUATION

Due to protracted decisions on many fronts and lack of worthwhile competition in the industrial sector generally, no concerted effort has been made to upgrade the technology that we have already known. Our industry is still dependant on age-old technology. This presupposes that unless a highly competitive spirit becomes inherent and a strong sense of competition prevails in our industrial sector, the urge to improve upon the existing technology will never be there. Apart from this, we have been witnessing over the years endless instances where due to eventual loss in business, our industrial undertakings are getting rusted driven to the golden path of making themselves 'sick', thereby creating deadlock in progress and forcing thousands of hapless labour into utter dispair. How distressing this situation is becomes more and more apparent when we observe how the advanced countries are making non-stop endeavours to further develop the technology already known to them and are also 'innovating' new technologies at the same time not only to ensure worthwhile progress in their present state of national development but to project technologies to secure their future as well in the midst of a world competition that will surely get to be fiercely aggressive even within a short span of time. What I am trying to stress here is that the outlook of these countries, on their industrial development has interwoven itself as a cultural characteristic bound by a firm resolve that they should always remain one step ahead of competition to protect themselves from annihilation.

On many occasions, we have heard that foreign countries are passing on to us only 'obsolete' technology. Yet. even adopting such 'obsolete' technology, it seems to me that our industries in some sectors are doing reasonably well, obviously due to absence of competition. Further more. it is alleged that foreign collaborators do not give us the 'know-why'. Perhaps, it is meant that the foreigners do not transfer to us the 'basics' of the science and engineering involved in the particular area of collaboration. Thinking the technological way as engineers are prone to. the natural question that immediately comes to mind is : 'After all. why should they oblige us by giving out their secrets'. Looking at it, our country had one of the largest engineering and scientific force in the world. which has won so many laurels even in the international field. In such a background, can we remain complacent simply hoping that the foreign collaborating and trading firms will furnish us all the information and data we desire to acquire from them on mere humanitarian and compassionate grounds? Would it not be fatal to themselves if they so help their Indian counterparts to outpace them in the foreign markets sooner or later? Obviously, the answer is that even to receive the foreign technical know-how, we must be prepared ourselves with basic R&D activities so that we can improve upon the knowledge and are not just content with "black-box" technology transfer.

To sum up, our benign government should also consider implementing suitable measures and actions to create conditions of competition — which will help our industries — in the public as well as the private sectors — to grow more and more competitive not only among themselves at home but in their dealings abroad. Such an enlightened approach on the part of the government is sure to imbibe a 'new dynamism' into our industries.

As partners in serving the great cause of the people, we engineers and technologists would heartily welcome some immediate short-term actions by the governmental authority while it further formulates a full-fledged long-range plan during the next Plan periods. Such a step would not only give a great impetus as well as the time to our industries to enlarge their own policy — promotion activities but to go ahead in a balanced way to build — I up and ensure a dynamic spirit of 'keen competition' to the benefit of all concerned.

TECHNOLOGY VIS-A-VIS MATERIAL RESOURCES

We have been thus caught up in a perplexing situation. To get out of this muddle, the first measure on which we should focus utmost attention is technology we need for developing our own material resources. The reason behind this urgency is very obvious. Foreign technology which we purchase is based on raw materials which the collaborators get indigenously or import from other countries. These materials are generally of better quality than what we have; and as such, the 'imported know-how' is closely geared with 'better quality' raw materials. Unless we become alert, refuse to accept this situation and increase self-effort to upgrade the quality of our own raw materials and resources, the taunting question: 'What will be the fate of our vast quantities of inferior grade raw materials will remain so for ever. Obviously, this will be a major problem, which must necessarily be solved by ourselves only.

To put it briefly, we cannot in utter despair allow things to precipitate. We should immediately take recourse to set right this unsatisfactory state of our technology because the situation may worsen as problems of technology become more and more critical in the years to come. Any procrastination or neglect would prove costly. What with our exports lingering behind imports and our major foreign reserves dwindling, we must start functioning more decisively and with greater confidence at once. The need for this urgency is all the more now that we would not have enough money to import technology as easily as we have been doing so far; according to a Member of the Planning Commission. Sure enough this will offer us, scientists and engineers a great opportunity — to be taken with a challenge — to work for and achieve, at least during the Seventh Plan, a state of self-reliance which is more meaningful than what it has been so far.

SOME SUGGESTIONS FOR THE BETTER

As engineers and technologists, we cannot rest content with pious wishes since the community demands of us many remedial measures to its basic problems. Taking these contexts into account, I would now like to make a few suggestions by way of strategies which we could easily adopt for our national development. As explained in the Technology Policy statement, we need industry for manufacturing goods for the masses. Quite so, I presume the goods and services so referred to are 'basic needs' and not 'luxury items'. Let us study this aspect a little deeper. We know:

— The government has been projecting the public sector as the 'king-pin' of the production system in the country; and

— Furthermore, it has launched the National Rural Employment Programme (NREP) and the Integrated Rural Development Programme (IRDP) to create employment.

These two aspects of development which I have cited here seem to be diverse; however, there is a close linkage between them. This will be evident from the following paragraphs where I have tried to explain how and why these different areas should be functionally coordinated together to derive productive results.

No doubt, the above two programmes (NREP & IRDP) are very laudable but it is a wonder how they would be commissioned in actual practice? Will mere allocation and disbursement of funds bring about the desired benefits? Unless definite production programmes are charted out the money so injected may prove to be detrimental as it may not produce an equivalent amount of goods and/or services.

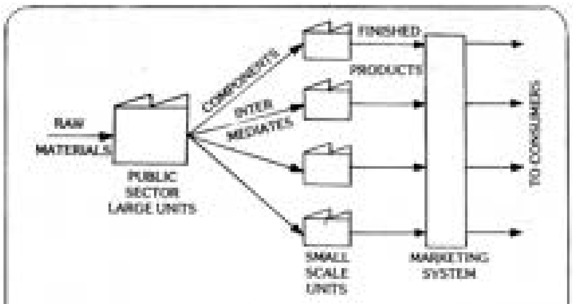
Such an imbalance between the input and the output will naturally bring many mighty 'middlemen' into the arena, in whose sole hands the money would get accumulated, thus depriving the poor masses for whose sake the above programmes are earmarked. One remedy seems to be that the monetary assistance given to implement the above programmes should go directly to help the production system so that it can make some value-added products thereby rejuvenating the economic health of the areas concerned. I would like to explain briefly how this can be effected.

End-Product Manufacture

As we-know, the normal linkage that now exists between small industries and large industries is that the small units supply the components and/ or intermediates to the large units, which ultimately make the markeatable value-added products. In this process of ancillarization, almost all the financial benefits that accrue go to the large units alone and pitifully, therefore, the small units are left to fend themselves at the mercy of their big brothers.

From what it is today, the production programmes of small industries and the financial returns they get are woefully dependent entirely upon the production programmes of the large industries. This has been greatly undermining the importance of our small industries. Traditionally, our technicians, craftsmen and artisans—who work mostly in small industries—are second to none and still, due to the inescapable dependance of the small industries on their large partners, and also perhaps due to unintentional actions on the part of the large industries, the importance of the technicians, craftsmen and artisans is not receiving the attention needed and as a result, this has tended to waste and stunt their skills and talents as well as their impetus to work at their best. This is certainly an alarming situation which, if left unnoticed, will be dangerous.

To prevent this situation deteriorating further, there are no doubt solutions. One that readily comes to my mind is to reverse the flow of components from large units to small units which will make the complete goods. I would henceforth like to call this process as 'End Product Manufacture'. In the case of consumer goods and consumer durables of basic nature, the components and/or intermediates can thus be manufactured by the large public sector undertakings because they have the facilities to adequately and efficiently handle difficult energy-consuming and pollution-intensive processes. The large units can then transfer the components to small units for making finished products. Such transfers will definitely economise the overall cost of the products since the various stages of production will get distributed between the large units and small units, offsetting to an extent the high cost of production borne in the case of the large units. To explain my proposal a little further, I will cite an example. For the manufacture of soap, vegetable or other fatty oils are reacted with caustic soda and this gives rise to glycerine as a byproduct. While this glycerine is recovered in large units, the glycerine is discharged as an effluent in the case of small units. The other way of manufacturing soap is by splitting the oil into fatty acid and glycerine and reacting the fatty acid with caustic soda. For further processing, the fatty acid manufactured by large units can be sold to small units which can make soap in a short time, without causing any pollution and utilizing much less fuel than required in the conventional process. This type of soap manufacture is not a new process. It has been a long-practised technological and commercial process in advanced countries. However, the finishing processes involve in soapmaking are not done by small units in these countries. My above suggestion is therefore particularly meant for meeting the peculiar situation in our country, as it would prove to be a worthwhile strategy which can ensure more beneficial linkages between our large and small manufacturing units utilizing the productive capacities of small units.



Flow Diagram of End Product Manufacturing
A Concept for Industrial Development
Complementarity Between Large and Small Units

This strategy of 'End-Product Manufacture' will also obviate the costly transport arrangements involved in moving the finished products to remote areas. Further, freight costs on transport of bulk materials will be much less than the finished product. Thus, one can appreciate that this much-needed process of 'End-Product Manufacture' can, to some extent, answer our national needs by facilitating manufacturing operation in different growth centres, and thereby giving definite inducement to entrepreneurs by involving them in direct productive practices and enabling greater employment of local labour force. Similar examples can be cited as in the case of manufacture of diesel engines, agricultural pumps, etc. In these cases also, the various intermediate and large components can be manufactured in lots at cheaper prices by the large units ensuring proper quality control. The components may then be transferred to the small units to be ultimately machined and assembled by them. This development strategy will ensure high efficiency in diesel engines and pumps which can be maintained throughout their working life as standard design and high quality components will be used during servicing. This alone can save the large amount of diesel fuel now being wasted throughout the country due to sub-standard and inferior quality components.

The list of such examples of End-Product Manufacture can include various other areas like consumer electronics, synthetic detergents, food preservation, health-care, etc.

TECHNICAL TRAINING AND RESEARCH

I have already made a mention of one of the important features of the Institution; that is, its multidisciplinary character and its main aim is to keep pace with the technologies of other nations to help the country in its progress. With this in view, commencing its activities with only two disciplines of engineering, namely, Civil Engineering and Military Engineering, at the outset, the Institution now has 12 Engineering Divisions encompassing every facet of engineering. Apart from its own all-India technical activities; each Division is also involved in framing and continuously updating relevant application-oriented syllabii for the Institution's professional examinations seeking guidance and assistance from its expert members consisting of practising engineers, specialists and educationists. Here lies the links of our Institution with industry.

All of us are quite aware of the tremendous upsurge that took place in the technical education systems of advanced countries in the late 50's following the first satellite put into space. After that, repeatedly fast changes have been overtaking the world with many sophistications in several engineering and technological disciplines, especially in the field of 'Electronics'.

These changes have been continuously percolated to the people as well in these advanced countries, who have become fully aware of the immense benefits that are pouring on to them thereby. On the contrary, in our country some of these changes have trickled with some success but only in pockets in some specific areas to a small section of the society; and that two mainly in the field of entertainment electronics mostly and its peripheral areas. As such, we have yet to build-in the basic infrastructural facilities upon which we can grow. All the same, in addition to electronics specially micro-electrontcs—we certainly need technologies in other frontier areas like bio-technology and alternative sources of energy, etc which have great potentiality in improving the quality of life. These technologies are all science-based and the industries based on them will be mainly of small-scale size. Dimensionally also, these technologies nicely dovetail not only with our vast scientific manpower and its capabilities but also with our need to induce dispersed growth Centres. Even assuming that we provide the infractural facilities mentioned earlier, we will not succeed in our objectives unless and until we acquire the knowledge and power to transfer science to technological processes and imbibe the concept of quality consciousness among all concerned. The first aspect, namely, transfer of science to industrial processes, is based on our 'design' engineering capabilities which we must have to develop unremittingly; arid the second aspect, namely, quality consciousness, is based on materials technology and instrumentation.

The largest gap in our technological development effort has been the lack of adequate capabilities in these very fields, namely, design and instrumentation. Added to this is the non-availability of proper materials of construction and components; and this gap is widening more and more as' new technology is involving 'extremely severe' process parameters like very high temperatures and pressures, very high speeds, very high vacuum, etc. These conditions demand use of special exotic materials and components which usually constitute an insignificant fraction of the total value of the equipment, but this difficulty can be conquered by importing such materials and components. Dispassionately looking, our inadequacy in design and instrumentation capabilities has thrown out to us immense opportunities to playa unique multidisciplinary role in meeting the continuing demands of new and emerging technologies. I wish to particularly stress again on the urgency for a multidisciplinary approach. In this context, I would like to cite an example in the field of chemical engineering. In the 50's the chemical processing industries were managed by chemists and mechanical engineers, and each of them thinking in his own way used to produce goods somehow to meet the demands of the time. This scene has drastically altered now with the many-sided advancements in the chemical production processes. One of the main reasons of this upsurge in the field of chemical production in recent years has been the emergence of the new-breed of chemical engineers whose professional education and practice have been firmly rooted on a multi-dlciplinary approach.

PILOT PLANT OPERATION

We have no doubt an array of highly qualified and talented scientists in the country. Unfortunately their inventions and discoveries hardly see the light of the day. As a result, we have already lost much and will lose even further if we do not make worthwhile amends, if we are to achieve productive results. What is the remedy?

Obviously, one remedy is to test the processes developed by the scientists on a 'proving unit', that is, on a pilot plant scale. Although pilot plant operation is of great significance it is unfortunate that the funding agencies, and even scientists and technocrats themselves, still have a lot of misgivings about such operations. Looking at the good side, the pilot plant should be regarded as a miniature unit to be operated as a regular production unit and thoroughly studied for identifying its characteristics, namely, process parameters, erosion and corrosion resistance, instrumentation requirements and overall mechanical reliability. The pilot plant should also be worked for a reasonable length of time to study and check up how it is influenced by seasonal changes and other factors. It is only through such pilot plants that we can hope to gain the needed confidence and capability to upgrade and enlarge their operations to the scale of successful production units. This exercise necessarily calls for a good deal of investment in as much as it cannot be merely limited to a simple laboratory testing affair with which the funding authorities and scientists have been familiar. The question, however, is: who will fund such pilot plant testing?

As explained earlier, the private sector would not be generally interested in such endeavours because the climate of competition is just not I there to the extent desired.

LINES OF ACTION

Judging by the benefits which would accrue to the country through commercial exploitation of the growing inventions and discoveries in the frontier areas, it is but natural that the government should be mainly responsible to fund pilot plant testing. In any case, at the post-graduate research level and in the national R&D organizations, the government is already footing the bills. A more beneficial utilization of this investment is only possible if ‘pilot plant operation' is also included in the programmes of these bodies. In such an event, it would become necessary on the part of our scientists to readjust their attitude to work and to 'degrade' themselves as 'production men' as well to carry out the pilot plant operations. Such an adjustment will go a long way in rooting out the present distinction and differences between scientists and design engineers; as well as the scientists' complaint that engineers fail to make good use of their inventions, and in turn, the engineers' rebuff that the design parameters evolved by the scientists are not amenable to engineering practice. Therefore, the pilot plant test platform can become a mutual meeting place of scientists and design engineers where more workable designs can be readily evolved suited to our conditions, capabilities and resources. Access may be imposed on the industries for funding the related projects.

I would now like to invite your attention to another priority area — namely, the need for changes and upgradation in our engineering syllabii at the undergraduate and post-graduate levels. As a Member of the Post-graduate Board of the Ministry of Education, Government of India, I have had the opportunity of discussing this problem with many others. We all feel that more multidisciplined post-graduate courses which have relevance to the needs of the community should be introduced soon. As practice now goes by, the courses are usually planned and designed by the faculty members themselves, mostly based on the pattern of such courses in vogue in the developed countries. My suggestion is that the faculty members involved in devising the post-graduate courses should reach out to industry and research institutions in their respective areas with a view to identifying the problem areas and the availability of resources and then implement post-graduate courses that are more meaningful and can better cater for the needs of the community.

PROBLEM AREAS IN THE RURAL SECTOR

Having had a brief probe of how and to what extent we must turn our attention to the various new frontier areas in the interests of our overall national development, we may now turn to a very important area of utmost concern to us, namely, the rural sector where our teeming millions live. This Convention has appropriately chosen for discussion the very many aspects of rural development. You may be aware in this context that the Institution has also recently started a Forum on Rural Development. I will take this opportunity to refer to some of the problems encountered in the rural sector and their possible solutions.

The crisis on the energy front in the next decades will not be in terms of automotive fuels or industrial fuels in our country as well in other developing countries but in cooking fuels in rural areas. In less than 30 years, our forest area has dwindled from 75 million hectares to 70 million hectares — causing a loss of about 5 percent. With our population fast increasing and costs of fuel soaring higher and higher denudation of our forests is sure to go on even at a faster rate. In view of the low productivity of our vast agricultural land, more and more of the forest area would be exploited year after year. Toward off this we must plan a concerted programme for evolving a cooking fuel which would not only need the help of technocrats, but socio-economists, administration and statesmen since this problem is not contained merely in the realm of technology only but extends beyond also.

Although we are doing our utmost in the agricultural sector, and occasionally by good fortune. we are reaping good harvests, intermittent drought and flood conditions have been persistingly causing scarcity. In both these cases of surplus and scarcity, we are facing difficulty Even with higher agricultural production, we are suffering high percentage losses during storage; besides this, the primary growers are also suffering losses due to unremunerative prices. We can save this situation by assimilation and devoted practice of post-harvest technology which is vital to our economic stability. However, we have not been exercizing ourselves properly in this area. In order to ensure our food security, we must go in a greater way for food processing. This aspect has still not received adequate attention from the administration, planners and the public. This will be evident from the large number of graduates of these disciplines who have not yet been provided with proper jobs. Even if we .can think of semiprocessed foods like extrusion-cooked cereals and related products which can be stored well and to meet the needs of our rural areas, they will provide adequately nutritious food to the people. Such buffer stock of food would minimize the violent fluctuations in food prices during glut and, scarcity conditions. Semi-processed foods would also need lesser fuel for cooking — which is an important aspect in the rural area. You will appreciate that this thinking is based on actual requirements of our country suited to its peculiar conditions and may not have any parallel in other developed countries. Who else but ourselves can sieze with these problems and seek solutions?

Obviously, the solution of this situation lies in a cooperative effort both technically and socio-economically. Hence, the administration should make efforts immediately to implement relevant action-programmes. We the technocrats are ready to respond.

TECHNOLOGY AND THE SOCIO-POLITICAL MILIEU

Thus, our problems of the future will not only be technical in their spread but will include the socio-economic dimensions as well. In this many-fangled unpredictable situation, it is the bounden duty of us engineers and technocrats to be ever prepared to take on the mounting challenges of the time and re-assure the government and the people at large that our professional knowledge, talent and skills will certainly be available to them to tackle and solve the technological problems. In such a context, it is obvious that our statesmen and leaders and administrators on their part, must take on the brunt to tackle the matching socio-political problems since, as already explained, technology alone will not be competent enough to save the situation.

In conclusion, I feel I have taken you through too much of your precious time in presentating this Address, which, as you must have observed, is a little departure from a conventional Presidential Address. I have done so with a set purpose — to say over and over again with a firm conviction that our future will depend upon how well we get prepared to accept and exploit continuous and rapid technological changes, but such changes inevitably bring problems, not the least the human ones in learning to live with the new technologies.

You will surely appreciate that amidst our progress we are also face to face with formidable challenges. Therefore, without the active involvement of those employed at all levels, we stand little chance of improving the quality of our life, the profitability of our industry and the prospects of our vast millions. A re-search of ourselves alone can illuminate both the achievements and the amount of effort still needed.

Yes, we have many different ideals about how life should be lived. The search for scientific truth requires that we disregard our individualistic value systems; but accept totalalistic values. It was Bertrand Russel who asserted in the same vein that 'those who forget good and evil and seek only to know the facts are more likely to achieve good than those who view the world through the distorting medium of their own desires'.

So this is engineering : a commitment to scientific truth and to the values which the search for this truth entails. Once we start to talk about utility for the society, we must leave the placid enviro laboratory, take off our white coats and roll up our sleeves. We are no longer considering theoretical forces and ideal substances. We are now obliged to work for the society with materials and environments that are real, impure and sometimes unpredictable. Our aim is no longer to discern absolute truth, but rather to create a product that will perform a function for the society.

Most experts have a way of avoiding blame by claiming that their ideas were not given a fair trial. Engineers have no such evasions. Well, so be it, Somebody has to step forward to do what needs doing. We can't all sit around being critics, supervisors and second-guessers.

We are pledged not to engage in wishful thinking but surmount difficulties. We are not the grass·hoppers: we are the ants; we know when winter is coming. We are committed to scientific truth, we believe that poetry and sermons alone are not an adequate foundation on which to build human society. Very often, our debates on 'national development' have tended to remain highly emotive generating more heat than light. But we believe in hard work. We demand it of ourselves and we require it of those who would join our ranks.

And we shall surely overcome all obstacles however mountainous.

We are ready.

JAI HIND

Shri S K Mukherjee — A Brief Profile

To hold the office of the President of the Institution is a unique honour, even though one of great responsibility with all the challenges associated with it. Each year the Institution performs an act of renewal by electing its President. This year this honour has been bestowed on Shri S K Mukherjee, FIE, Managing Director, Basic Technology Pvt Ltd, Calcutta, who has been unanimously elected President for the Session 1984-85 at the December 1983 meeting of the National Council of the Institution at Cochin. Shri Mukherjee will succeed Shri MD Patel, FIE, the retiring President, at the Inaugural Function of the 64th Annual Convention to be held at Patna in early February 1984. Shri Mukherjee's own dynamic professional life and enterprise, dedicated participation and outstanding contributions for the advancement of the engineering profession and to involve and lead the membership, and engineers in general, in the cause of technological development of the nation as a whole make him one of the country's most enlightened, distinguished and exceptionally qualified personalities to occupy the above prestigious office. The Institution extends with utmost pleasure a hearty welcome to person of his eminence who has immensely lent great wisdom and stewardship to fulfil the Institution's various obligations and commitments for nearly three decades.

Shri Mukherjee hardly needs introduction. As a dominant figure in the field of engineering and industrial enterprise, blessed with a meritorious technical and professional background that has remained inseparable from his profound interests to further the frontiers of the institution and the flame of its fame both nationally and internationally, Shri Mukherjee has mightily shared his precious knowledge, experience and energy in various assignments of vital importance to the Institution. As a chemical engineer par excellence and as a very senior member of the Council, the score of professional offices he has held and his achievements for the Institution thereof have been profuse and noteworthy.

In his office as Chairman of the All-India Chemical Engineering Division for several terms, backed by his firm conviction that an intellectual interdisciplinary approach is most essential to tackle the technological problems faced by industry, he was responsible for organizing numerous seminars on chemical engineering vis-avis process industries. These were not only very successful but helped greatly to bring about a close-knit and meaningful relationship between industry and engineering and professional institutions on the one hand, and research and development organizations and universities on the other. As Honorary Director of the Engineering Research, Development, Design and Consultancy Cell at the West Bengal Centre of the Institution, he started a scheme to involve and utilize the experience of retired scientists and engineers (on a voluntary basis without financial benefits for themselves) for development of projects which have beneficial impact on the weaker sections of the society.

In the background of his exceptional academic and administrative career, and his scientific reknown and formidable research achievements, his involvement as Investigator in Charge of R&D projects, namely, (a) De-Salination of Brackish Waters; and (b) Fibre from Pineapple Leaves bear witness to his great enterprise, expertise, deligence and dedication to simplify, diversify and spread the results of R&D to the common man. The first project involved him in design engineering for evolving a small plant to desalinate brackish waters by the most modern process of Reverse Osmosis. The operation and maintenance of the plant so. evolved could be handled by rural technicians. There has been great appreciation that application of the above concept in rural areas, specially in coastal area, will have a tremendous impact on improving the health of the villagers in as much as contaminated water can be eliminated and fresh drinking water made available; and in turn, this would allow new habitat to grow where natural drinking water is scarce or not available. The aim of the second project was to develop a new type of machine for decortication of pineapple leaves. The resulting fibre serves as useful material for making cloth for rural people, as also for industrial purposes. This technology for waste conservation has been applied not only to cater for the needs of the community but to generate potential income centres in the rural sector.

A creative thinker with a zest and commitment for change, his innovative contributions have earned for him national recognition in a variety of ways. In a sense, he is a dual personality — a hard-driving engineer and a reflective industrialist as well. A staunch believer in self-reliance, he has an almost occult gift for pinning down essential areas which need engineering and R&D

programmes for indigenous development. During his service career, he was wholly instrumental for planning and carrying out a number of projects which stress on self-reliance. He has a commanding intellect for design and development of processes and products and his vast experience has covered the development and manufacture not only of industrial chemicals and consumer goods but precious life-saving drugs.

Sure enough, with all his conviction that the nation should change its technical-orientation towards a hardnosed pragmatic approach to achieve self-reliance as well as to combat and bridge the widening gap between basic and applied technology to tackle the many problems of the masses. Shri Mukherjee's professional endeavours have also involved him in the design and development of a series of high-technology processes, products and equipment — like spray-drier which is widely used for production of 'Instant Tea'; catalysts for cracking petroleum products and preservation of food products; and special filters and drying equipment which enable beneficial utilization of low grade indigenous phosphate ores. Taking advantage of the all round technological revolution which has been opening new concepts and new frontiers, Shri Mukherjee has valid claims as the first to develop and direct practical application of fluid-bed drying and fluid-bed granulation processes which are in great use in the fertilizer industry, drug industry and food industry and in-various sectors such as the defence department, public sector undertakings, multi-national companies and small scale industries. In the background of his penetrating insight, scholarly rectitude and sure craftsmanship, Shri Mukherjee's profound concern has been that the country should no longer import 'black-box' hardware but achieve results through its own high-technology reaches suited to economy of scale, skills and market forces to create wealth for the nation.

Notwithstanding his innate interests in down-to-earth engineering, Shri Mukherjee has shrunk at no toil to make his influence felt in other domains as well. As a great guide to the younger members of the profession, he is an ardent advocate of application-oriented approach to engineering education vis-a-vis the profession—industry relation. His stress has always been that academicians should 'reach out' to industries and thus break the inhibition of practising engineers and technologists to bring about a more meaningful cooperation between education and industry. His philosophy in this context is one that emphasizes cultivation of responsible attitudes and built-in concensus within and between groups to ensure that technology based on mutual understanding and effort can widen the horizons of innovation in the country as a whole. His efforts in this direction have been overwhelmingly applauder I, as evident from his many creative contributions to help industrial growth and absorb changing knowledge ever increasingly.

Shri Mukherjee has been rendering yeoman service in the sphere of education as well. As Adjunct Professor of the Indian Institute of Technology, Kharagpur, for Post-Graduate Courses, his plea to the faculty and students is to be continually aware of the current problems of the nation as well as how other countries have tackled such problems. He is also a member of the Basic Chemical Engineering Sub-Committee of the Indian Standards Institution and has closely involved himself in the formulation of standards appropriate to Indian conditions, community skills and natural resources.

Shri Mukherjee began his engineering career by obtaining his Bachelor Degree in Chemical Engineering from the Jadavpur University, Calcutta, in 1948, standing First in First-Class Honours. His academic distinction brought him the Jatindra Krishna Gold Medal awarded by the University. He had specialized training in petroleum engineering in the UK during 1954-55. As an on-going innovative engineer in further years, his dedication to the work of research, design and project development earned for him numerous recognitions. He is a recipient of the National Award, made by the Board of Import Substitution, Government of India, for developing the colloid mill for production of high protein foods and the high pressure homogenizer for application in food and drugs industries and production of industrial and textile chemicals. For his excellence in the design and development of high technology equipment like thin-film evaporator, scraped-surface crystallizer, solid-liquid separator, he was conferred the NOCIL Award by the Indian Institute of Chemical Engineers.

Shri Mukherjee has also presented a number of papers at national and international conferences. Shri Mukherjee joined the Institution as Associate Member in 1953. Besides being a highly respected Council Member of long standing (holding a unique record of being returned to the Council without any break for a period of 20 years), he is a leading Fellow of the Institution. Shri Mukherjee is also a

Member of the Indian Institute of Chemical Engineers. Further, he holds Licence as a Boiler Operation Engineer.

To Shri Mukherjee, engineering is the most exciting and personally rewarding profession one can practice. He takes 'it as a challenge worthy of best efforts, with an unshakeable belief 'that to design something which works is not enough: it must be 'indigenous and economically sound'.

Sharing his 'deep-rooted knowledge' is a pleasure by itself. With his kindliness, understanding and helpful nature, as an enterprise-filled leader and intellectual, Shri Mukherjee brings to the Institution a wealth of experience and wisdom which will playa great role in helping it to seek out newer strategies to achieve many more successes. His selfless work and devotion so unremitingly given, it is hoped, will help the country even more in the light of the 'Technology Policy' announced by our Prime Minister in her recent Address to the Nation; and the Institution to raise its image and its learned and professional attainments to a 'new high'.

Shri C R Alimchandani
President 1985-86

Presidential Address

His Excellency Shri D.P. Mehra, Governor of Rajasthan, Honourable Union Minister for Education, Shri K.C. Pant, Honourable Union Minister of Law, Shri A. Sen, Honourable Chief Minister of Rajasthan, Shri S.C. Mathur, distinguished guests from overseas and sister societies, engineer friends, ladies and gentlemen.

The Institution of Engineers has behind it a glorious tradition of service which goes back sixty-five years. It is pledged to work for, and represent, the engineering community belonging to fifteen disciplines and consisting today of approximately one million engineers and technicians. The membership of the Institution exceeds two hundred thousand, out of which fifty thousand are Corporate Members and the balance are Student Members. It is my duty, during the next year, to be their first servant, and along with them, to help the Institution to realize its principal objective of providing the highest level of engineering service to the Nation.

We are grateful for the gracious presence of Shri D.P. Mehra, Shri K.C. Pant, Shri A. Sen and Shri S.C. Mathur. By being here with us, today, they honour the Institution of Engineers, as well as all the engineers and technologists of our country.

The Institution of Engineers has a critically important role to play in building up the qualitative and quantitative strength of India's engineering manpower falling under each of its 15 disciplines

:—It provides professional feed back to update the technical education programmes of our Universities so that they are in dynamic equilibrium with the development needs of our country. It has just made revolutionary modifications in the syllabii of its own graduate engineering examinations. These new programmes will have, in the coming years, a far reaching impact on engineering courses conducted by all educational establishments.

:—It functions as India's largest open Technical University. It provides at present an opportunity to one hundred and fifty thousand young people to appear for examinations leading to a Degree in Engineering.

:—It constantly updates the knowledge of practising graduate engineers by publishing technical journals and by conducting, technical lectures, seminars and continuing education programmes at 64 centres spread across the country. In the last year, the Institution published around 500 articles in some 50 issues of its journals, it published 12 issues of its technical news bulletin, it organised 1100 lectures, 113 seminars and 80 continuing education programmes. Through its Central Engineering Staff College, already taking shape at Hyderabad, the Institution will be developing high quality postgraduate continuing education programmes, and disseminating them at Hyderabad as well as at 1311 local centres. At Hyderabad it will create a central computerized technical information bank, which will add, a new and powerful resource, to the existing technical libraries at its many centres.

:—It invites every year an international technical congress to our country so that during each such event about one thousand Indian Engineers can study the work of between one and two hundred Indian and World experts, and exchange views with between one to two thousand overseas delegates. If we consider that the country normally permits only around ten Indian Engineers to attend such Congresses held overseas it becomes evident that the same events held in India will result in a hundredfold increase in our participation leading to a very powerful impact on. and acceleration of, our country's technical progress. In 1983 it hosted the World Energy Congress; in 1984 it organised the World Mining Congress; this year it will host at New Delhi, between 7th and 9th November. the World Congress on Engineering and Environment organised under the auspices of the World Federation of Engineering Organisation (WFEO), whose around 80 countries. including India. will meet just afterwards to review and chart out a future plan of international technical co-operation; in 1986, from March 16 to 20th, the Tenth World Congress of the International Federation of Prestressed Concrete (FIP) will be held at Delhi. Because of the outstanding achievements of India in this sophisticated field, this Congress is meeting for the first time on the soil of a country from the so called developing world. An appropriate theme has, therefore, been chosen for the Congress: "Structural Concrete in the Developing World". When you consider that construction represents more than half of India's development expenditure, out of which approximately one fourth is spent on concrete tit is estimated that in 1983 India spent Rupees 6000 crores on plain and structural concrete). you can. realise the impact that this great exercise of technology transfer and exchange of views between 2500 foreign and 1000 Indian delegates, can have on the Indian economy. In my experience as a designer of major as well as the more usual structures relating to every branch of civil engineering. I have found it possible to frequently save between ten and thirty percent of the cost by adopting modern design and construction techniques and also to achieve a substantial improvement in quality-and anticipated life of the structure. If such knowledge is generalised, and extensive vocational training is also given to skilled labour, it is not inconceivable that the average cost of concrete construction could be reduced by say 5% in as many years. The important service rendered to the country by organising these four International Congresses can be-better judged when we realize, that the fields covered, taken together, represent nearly half of India's current development expenditure. The Institution is a National Member of 8 World Federations of Technical Societies which organise such International Congresses, and therefore it will, in due course, be able to bring to India a succession of valuable International Congresses.

:—The Institution of Engineers has set up, or is processing, bilateral agreements of technical co-operation with Institutions of 14 Countries and the presence here of so many delegates from countries far and near bears witness to this invaluable fraternal co-operation. It is also a source of great happiness that we have joined hands with the Engineering Societies of our neighbours, Bangladesh, Nepal, Pakistan and Sri Lanka, under the banner of the Federation of Institutions of Engineers of South and Central Asia (FIESCA), which has already begun sharing the knowledge and resources of our technical communities with the object of solving more rapidly the many common technical problems which arise out of our similar economic and social structures. This cooperation is particularly dear to us, because we see across this live and healthy technical co-operation, the hope of ushering in closer economic and cultural exchange between the countries of this subcontinent and its neighbours in Central Asia who are expected to join this Federation in the future.

— The Institution also runs its own overseas chapters which service its members working overseas, and also forge links with engineering societies of the countries in which these chapters are operating.

— It meets once a year in an annual national convention which brings members of all its disciplines together to hear outstanding Engineers deliver memorial lectures of high philosophical and technical content as well as very advanced state-of-the-art lectures relating to each discipline. Matters of interest to the profession are also discussed. Its centres celebrate with verve their own annual conventions. From this year there will be fifteen additional national conventions — one for each discipline — which will permit very intensive technical deliberations within each specialisation.

— These activities are complemented by a great many others required by our profession. I have enumerated only the principal ones to bring out the national and international dimensions of the service provided by the Institution to our Engineers, and through them, to our country.

I would like to share with you some thoughts on the Indian Engineer and his relationship with our society and its future.

The Engineer's role is inadequately understood, perhaps because he works somewhat removed from the gaze of the general public. It is scarcely realised, that none of our development plans could have been implemented without an engineer in command. An Engineer is in essence a specialist dedicated to, and remains at the core of, nearly all modern production activity. He contributes to the creation of nearly every product we use or consume. Consider, for instance, the food we eat: an engineer has contributed to its production by the manufacture of fertilizer, the supply of water for irrigation, the building of silos for its storage, the creation of roads, railways, ports, airports and the manufacture of trucks, trains, ships, airships and the fuel required for its transportation, as well as for our transportation, to markets where it is sold — and those very markets have also been designed and built by Engineers. Members of the medical profession perform the function of relieving human suffering and come into close contact with the public. They are seen to receive society's very well merited esteem. But the professional who organised the manufacture of the sophisticated as well as traditional. diagnostic, medical or surgical equipment, every medicine and every bandage used in the practice of medicine, remains unseen and unacknowledged.

I seek not the esteem of society as reward for the Engineer's work. All I desire is that our country visualizes correctly the key role her Engineers must play in solving her great economic problems, that our country understands and entrusts the Engineer with his correct responsibility so that, within the next decade and a half, he can effectively contribute every iota of his strength to:

— eliminate hunger from every Indian stomach — which means creating adequate earning capacity as well as producing enough food,

—provide clean drinking water, sanitation and medical facilities so that the average Indian's life expectancy becomes at least 60 years,

—provide a roof over every Indian head,

— provide facilities for secondary education, including television and video, within walking distance of every village and in every low income urban locality so that every child born to Indian parents after 1995 gets compulsory secondary education,

— create facilities so that every member of a rural community is educated on population control, modern agricultural methods, modern water, land and forest utilisation and conservation practice, basic sanitation and technology adapted to the rural environment,

— ensure that urban, industrial and rural areas of our country are energy sufficient with the correct balance between conventional and non-conventional decentralized renewable energy source,

—connect rural areas by roads to the country's highways,

—arrest the flow of population from the rural to the urban areas of India,

—halt the brain drain,

— ensure that India takes her rightful place among the first five industrial and agricultural powers of the world and that its industrial products compete in the world market, in quality and in price, with those of Japan and the Western World.

Before you conclude that these are only dreams, please consider that:

— More than 170 million Indians live in its urban and industrial centres, and at least half of these have reached similar educational levels, and exercise similar responsibilities as citizens of any industrially advanced nation of Europe. In terms of size this part of our population is nearly two times that of the larger Western European Nations and three quarters that of Japan. The other half of our urban population, as well as the more educated portion of our rural population, wait in the wings to join this elite of our country within the next decade and a half,

— About ninety percent of our population of 750 million still works in the more traditional sectors of our economy and forms one of the world's largest and cheapest reservoirs of agricultural and industrial labour,

—our land area is 6 times that of France, 9 times that of Japan, 12 times that of Germany and 13 times that of Great Britein.

—India is potentially the third richest agricultural country in the world with a total arable land area of 140 million hectares and has an average annual rainfall of 85 centimetres. Her total water resources are the seventh highest in the world.

—India's energy potential can be gauged from the following facts:

- Its hydro electric resources are the thirteenth highest in the world, half those of Japan, 6 times those of France, 19 times those of Germany and 39 times those of Great Britain,
- Its nuclear fuel resources are the ninth highest in the world, half those of France, 4 times those of Japan and 30 times those of Germany,
- Its renewable bio-energy resources are the second highest in the world,
- The solar energy falling on its land is probably the sixth highest in the world — to this is to be added the solar energy falling on the seas around India,

• Its coal based resources are the ninth highest in the world, half those of Germany, more than 2 times those of France, 3 times those of Japan and 6 times those of Great Britain,

• It will reach self-sufficiency in petroleum and natural gas production in the next five years and it ranks seventeenth in the world based on its known resources of liquid and gaseous hydrocarbons,

— Apart from coal, its other major mineral resources, when aggregated are the seventh highest in the world, 3 times those of Japan, 6 times those of Germany and 5 times those of France.

With all this human and material potential, can anybody doubt that it is possible for India to make in the next fifteen years an industrial leap greater than that, made by Japan between 1960 and 1975.

With these goals, so close within our reach, what really does our country need to fulfil them? Please believe me, all that our country needs is "Good Management".

She has already placed at her helm an energetic man with a modern technological and professional culture. He has gathered around him close advisers who seem to comprehend in a more pragmatic manner, the dynamics of development of modern industry and agriculture and the various other sectors of her Urban and Rural economy.

He needs only his second hundred days in office to cut across all barriers to identify the most outstanding Engineers, Economists, Scientists and Managers, in order to create a powerful Brains Trust which will help draw a perspective plan for India's development over the next two decades, and enforce its implementation, so that by the turn of this century our country delivers

all its achieveable promise.

If India is one of the few countries of the world to have an independent nuclear capability, it is because Rajiv Gandhi's grand father could identify and entrust India's Nuclear future to a Homi Bhabha and then to a Vikram Sarabhai, and Rajiv's mother could later entrust this work successively to a Homi Sethna and a Raja Ramanna. If India has the seventh highest position in the race to space, it is because technologists of the same calibre were identified by the country to head this activity.

Can anyone doubt that the Indian technological community has produced in the last 30 years of development, in each of its specializations, at least one outstanding mind which is capable of achieving for India her true technological and economic destiny — the country has only to look for those who have already reached the peaks of technical, financial or managerial achievement in each sector of our economy.

To prove my point it would be possible for me to give you details of achievements of international calibre by the most outstanding members of my own engineering disciplines: Civil & Architectural Engineering, which cover between them more than half our country's development expenditure. Experts of international standing in other disciplines can also be identified. Within a year a feasible perspective plan which will achieve these goals can be prepared.

We could spend hours detailing these thoughts. But, with the greatest humility, I say that truth, to be perceived, requires no more telling.

Let me close by seeking your blessings and prayers for the work of the Engineer, so that he may gather the bounties of land, sea, air and space and harness the great forces of nature for the benefit and happiness of his fellow beings, his and our country and his and our universe.

Thank you,

A Brief Profile

Shri C R Alimchandani, BE, FIE, Chartered Engineer, a distinguished Civil and Architectural Engineer and acknowledged authority in these fields, both at home and abroad, presently Chairman and Managing Director of STUP Consultants Limited, who has been honoured with many coveted distinctions for his outstanding contributions and dedicated services in the fields of Civil and Architectural Engineering has been unanimously elected President of the Institution of Engineers (India) for the Session 1985-86.

Shri Alimchandani is a man with a pioneering zeal who is always willing to take up fresh challenges. A quarter century earlier in 1957, as a young man fresh out of the University of Poona with a first class first in civil engineering, he said : "I want to be an outstanding achiever and create outstanding structures", and he proceeded to do just that, designing major structures that have won international accolades and set new standards in the design and construction of concrete and steel structures.

In 1958, he was awarded a French government scholarship for advanced studies and training in prestressed concrete design and construction, and secured the OCT. He joined STUP Paris and worked with Yves Guyon and Pierre Xercavins, prominent colleagues of Freyssinet, the inventor of prestressed concrete. Shri Alimchandani says: "I was attracted to this field because it was new, and in the climate of idealism prevailing at the time, it was in keeping with Jawaharlal Nehru's vision of developing technology that could be effectively applied to the third world".

Guyon possessed a missionary fervour and wanted to transfer these new technologies to countries like India which had a reservoir of highly qualified engineers. He visualised that India had the human potential to play the role of a leader in civil engineering technology. Thus in 1963, STUP Consultants Ltd was set up at Bombay with Yves Guyon as its first Chairman.

Shri Alimchandani joined STUP Consultants Ltd as Deputy Chief Engineer in 1963. In 1967, he took over as Chief Engineer and by 1972, at the age of 37, he was appointed the company's first Managing Director—in 1975 Chairman and Managing Director.

Under his stewardship, he has been able to create a nucleus of brilliant and dedicated engineers and architects, who from the beginning have created many outstanding structures which have won international recognition. Some of these projects have established world records at the time of their construction. Over the years, they have applied their skill to nearly every field of civil and structural engineering and architecture including Bridges and Roads, Railway Infrastructure, Airports, Ports and Harbours, Irrigation and Public Health Engineering, Nuclear and other Power Project Structures, Industrial Projects, Urban Development and Building Architecture. They have achieved landmarks in every field and been able to advance technology benefiting not only India but also other parts of Asia and Africa and in the process earned respect from even the developed countries for these achievements. Shri Alimchandani's dynamic leadership has enabled his company to establish itself in eighteen locations across the world.

He was awarded the ACTIM Medal in 1976 for the most "outstanding professional" trained by the French Government Agency ACTIM. He is the first individual awarded this honour among the 35,000 selected experts trained by ACTIM in twenty years since 1956.

His deep interest in ancient and modern art, archaeology and classical music and his involvement in the Rotary movement for aid to the under privileged, has given his many-sided personality a special ambience.

Shri Alimchandani is affiliated to several National and International Associations. He is a member of the Executive Committee/Council of the Indian Roads Congress and the International Association for Bridge & Structural Engineering — Indian National Group. He has been deeply involved with the Institution of Engineers (India) for several years. He is a Council Member of the Institution of Engineers (India) and Chairman of its Architectural Engineering Division, where he pursues his favourite project "to bring together architects and engineers in a common forum". He is also Vice President from India for the Federation Internationale de la Precontrainte (FIP). Through his efforts, the FIP '86 Congress will be held for the first time away from Europe and America in a third world country—India. At 49, he has achieved the high honour of being elected President of the Institution. This is one more tribute to the man who 25 years ago wanted to be "an outstanding achiever".

Shri Alimchandani's election has indeed come as a momentous and renewed recognition of his many-splendoured personality and distinguished achievements and underscores the Institution's commitments and all-out efforts to ensure attainment of the highest levels of technical excellence and competence for the engineering profession in the country in serving the great cause of the nation. Under his dynamic leadership, the profession hopes to reach greater heights in fulfilling the peoples' aspirations.

Prof B R Narayana Iyengar

President 1986-87

Presidential Address

TOWARDS NATIONAL ADVANCEMENT

I wish to express my sincere thanks to my colleagues on the National Council of our Institution for having elected me, a mere retired teacher, to the highest office of our Institution. This is indeed a great honour bestowed on the profession of engineering teachers and I accept, on their behalf, this honour with all humility.

I hope with the help, co-operation and guidance, not only of all my colleagues on the Council but also all our members, young and old, I will be able to shoulder the onerous responsibilities of this high office, in a satisfactory manner and maintain the dignity and prestige of our great Institution, which has been established by a galaxy of past Presidents.

I shall not attempt to talk to you of anything highly technical or academic, since I am aware that most of you are far more knowledgeable than myself in the theory and practice of engineering and technology. However, for quite some time past, there are some disturbing thoughts regarding our national advancement which I would like to share with you on this occasion.

We talk of countries as developed, developing and under-developed. What does development of a country mean, and how are we to assess the same? Most of what follows has been said by many at different forums on various occasions. Yet, these not only stand repetition, but deserve serious thought particularly by our younger generation, who are our future citizens.

NATIONAL DEVELOPMENT

In 1961, the UN General Assembly issued an appeal to the conscience of mankind and called the decade of 1960's as the UN Decade of Development, and the then Secretary General, U Thant. stated:

'We are beginning to understand the real aims of development and the nature of the development process. We are learning that development concerns not only man's material needs, but also the improvement of the social conditions of his life and broad human aspirations. Development is not just economic growth, it is growth plus change. As our understanding of development deepens, it may prove possible, in the developing countries, to compress stages of growth through which the developed countries have passed. It may also be necessary to examine afresh the methods by which the goals of development may be attained.'

'In the year 1971, the second UN Development Decade was initiated with the clear understanding of the vital role that science and technology have to play in achieving the developmental objectives that have been set forth. It was noted that in spite of the continuous attempts to adopt scientific measures for, furthering international cooperation, for achieving overall worldwide development, the living conditions of countless millions of people in the developing countries continued to be extremely low and were undernourished, uneducated, unemployed and were lacking in many other basic necessities which people in the affluent countries took for granted.'

DEVELOPMENT INDICES

For quite some time, the rate of growth of the gross national product (GNP) has been taken to indicate the progress of a nation. While this may be a convenient index, it certainly does not reflect the actual state of the people in a country. An increased income amongst the affluent does not necessarily mean that the increased income is shared with the poorer sections. Even if some legislative or other coercive measures are taken to achieve this sharing, it does not follow that the physical well being of the people will improve. This index does not tell much about the 'quality of life' that has been actually achieved.

Many 'developed' countries, with high rates of growth of GNP, suffer from very undesirable social consequences such as high rates of suicide, divorce, crime, drug abuse, etc. Also, the breakdown of the social structure, in terms of family units, is a matter of grave concern. Any development index should reflect the general well being of the people.

Considering such constraints, the Overseas Development Council in the USA has suggested an index called 'physical quality of life index' (POLI). In this, three parameters, viz. (a) infant mortality, (b) life expectancy, and (c) literacy are considered. This index was supposed to assess the wide range of conditions that a minimum human needs programme might attempt to improve. While this index is perhaps better than the GNP, still, it does not attempt to quantify such abstract parameters as justice, political systems and happiness of the people. This index also does not attempt to assess if the basic needs of individuals are met and does not indicate directly the country's economic development.

The Association for the Application of Science to Human Affairs (ASHA) at the Indian Institute of Science, Bangalore, have, in their paper presented to the UN Conference on Science and Development in 1978, suggested an index particularly suitable for developing countries. The parameters used are: (a) employment (b) literacy (c) health, and (d) productivity. The paper points out: ,

'We believe that by providing these prerequisites for a contented life by increasing the level of availability of these four parameters, we are essentially increasing the level of development of a developing country. We have taken the percentage of gainfully employed people in the country as an indicator of the level of employment, the percentage of literacy in a country, as an indication of the level of education. We have tried to quantify the health care in the country by using the birth rate, infant mortality and life expectancy. The productivity of a country is 'probably best described by the rate of growth of GNP. A composite index is obtained by the product of these quantities with employment, literacy, life expectancy and productivity in the numerator and birth rate and infant mortality in the denominator. The index yield a number which is to be used as a measure of the level of development.'

The paper indicates that even this index is not a complete answer, to the problem, as several very important parameters have to be included if the index is to truly reflect the state of development. The index does not take into account the role of women and their living conditions, the availability of appropriate health needs such as the number of hospital beds and doctors per thousand population, the teacher-pupil ratio in educational institutions, etc. Also the concept of employment would vary from country to country. In many developing countries a large number of women work at home leaving other people in the family to do more productive work and a large number of women in rural areas work as unpaid agricultural labour. Employment statistics should take into account all such and many more factors.

The ASHA group and several others are no doubt finding more appropriate indices to assess development of a country but the fact remains that there are a number of factors which cannot be quantified; as, for example, happiness in a family, contentment and freedom from want, etc.

EFFORTS TOWARDS INDIA'S NATIONAL DEVELOPMENT

Since independence in 1947, there has been an endeavour to bring a better social order based on a balance between personal liberty and social needs, private enterprise and social control, ancient culture and modernization, national planning and local initiative. We have opted out for universal adult franchise and have created the largest electorate in the world. Our constitution is based on justice. liberty, equality and fraternity as the foundation. We have maintained successfully the parliamentary democratic form of government, in spite of a number of acute internal problems and external crises. We have advanced in the matter of industrialization and in the matter of self-sufficiency in food production. We have also succeeded in keeping the nation's entity intact in spite of internal diversities in culture, language, religion, geographical features and differences in economic performance. The characteristics of the Indian outlook today has been readiness to change without denial of our past traditions and culture.

We have the means to eliminate extremes of mass poverty, to bring about basic changes in the production system and the distribution of wealth and income and to achieve new values of social relationships and responsible citizenship. However, the progress has been slow, and the spread of the benefits uneven. Added to all this, the diversion of our resources to war efforts, and international constraints placed on our scarce resources, have brought about the most serious economic crisis the country has ever faced since independence.

Many of you have lived in pre-independence days as well as in the post-independence period. Nearly half my life has been spent in the erstwhile princely state of Mysore, which was then considered a 'model state' with good administration, and the latter half in independent India. I am sure, you will agree with me, that while even earlier there were disparities between the rich and the poor, the lower middle classes in those days were much happier than the present day upper middle classes and even the rich. The younger generation then, were not as agitated and angry as they are now. Crime, violence and corruption existed to a lesser degree. No doubt, we have made rapid strides in industry, education, food production, textiles, and health care, etc. Yet, we have large scale unemployment, illiteracy, poverty and illness. The population explosion is no doubt an important cause, but the question is: Are we having our priorities correct and are we following a correct path for national advancement?

CONCEPT OF BROAD BASED DEVELOPMENT

In an article entitled 'Directions of National Development,' Sm Rajammal P Devadas, a nutrition scientist of international reputation, says:

'Development is a total process in which all aspects of human life aspirations, education, health and nutrition are involved and evaluated on the touchstone of economic growth and living standards, Development is a 'social process which results in a cumulative increase in levels of consumption.' It is the evolution of a different art of living and working together. It is all-round growth of the economic structure to attain substantial and continuing increases in the standards of living of the population. Therefore it embraces all aspects of social behaviour — law, order, business, relationships in the family, literacy, use of gadgets and so on. Social change is more difficult to control than economic change. In our anxiety to promote economic change, we often tend to disregard both the social obstacles and social tensions which economic change so often gives rise to.'

Faster economic growth can be achieved by making good use of the workers, thereby involving more people in development. Our country has vast resources in its large manpower, animal power, and other natural resources, both existing and potential. It is said that participation by all the people is both the means and end to development. Countries like Japan, Taiwan, Korea, Egypt, Yogoslavia, Israel and Puerto Rico are cited as examples for implementing national development policies in which the great mass of small producers, farmers, artisans and tiny entrepreneurs have been involved in development.

Whatever be the stage of development of a country the most important investment it can make is in its human resources. A nation can progress only if its people believe that they belong to it and have a stake in its survival. This can be achieved by decentralizing the decision-making process in all aspects of human endeavour. Rapid economic progress requires that viable local organizations be integrated into the national system.

Our great engineer-statesman, Dr M Visvesvaraya has said almost 30 years back, in his book 'Memoirs of My Working Life,' in the chapter entitled 'Nation Building and National Efficiency'.

One important development in future will have to be that the responsibility for rectifying deficiencies and effecting improvements and developments of a nationwide character should be localised, that is, suitably subdivided and shared even by small regions, as far as possible, in proportion to their population and resources. If proper statistics are maintained, a correct picture of almost every phase of development needed, whether in a region or a state or in the country as a whole, would be always available for guidance.'

'The policies in the immediate future should, therefore, be to localise effort connected with large scale development by subdividing and distributing work over wide areas to promote self help. Certain national policies will have to be standardized and rendered popular in order to increase production and service, and thereby provide additional employment that is needed to protect the people from poverty and destitution.'

EDUCATION

An area of strategic importance to the process of development is education. Lack of education would naturally lead to indolence and absence of ambition. The capacity for organization and creative power remains low or lacking: In the preface to the Government of India document 'Challenge of Education — a Policy Perspective: Shri K C Pant, former Union Minister for Education, says:

'In our conditions. the role of education is to transform a static society into one vibrant with a commitment to development and change. An important ingredient of this metamorphosis is the emergence of a learning society in which, people of all ages and all sections not only have access to education but also get involved in the process of continuing education. In this environment, open, non-formal, part-time and adult education becomes as meaningful as formal education; in fact, the two streams reinforce each other.'

'The role of education in economic development is very substantial and several principles have to be adopted in mass education. These are: (a) education should be in close harmony with the requirements of the country both technical and administrative, (b) the creation of a disgruntled intellectual community should be avoided, and (c) the intellectual should be in close touch with the life of the community. The wealth of a nation depends ultimately on the productive skills and the levels of education and training in schools and universities. Farmers, businessmen and all others need to be educated. The fruits of science and technology have to be applied throughout the economy for constant innovation. If men and women have knowledge, experience, self-dlsclpline, power to take a long view, willingness to be evaluated by reason and observation, readiness to learn new and better ways of doing things, responsiveness to opportunity and adaptability to change, such men and women will be assets to the nation. Education should aim at imparting these qualities. Dr V K RV Rao, renowned educationist and former Union Minister, observes in his publication 'Values and Economic Development':

'Widening people's horizons through general education and practical training, is a precondition to development.'

SCIENCE AND TECHNOLOGY

In the final report of the 1981 International Congress on 'Science and Technology Education and National Development,' under the auspices of UNESCO, it is observed that:

'Science and technology are not a panacea for solving all the problems confronting humanity today. If not developed and used with discretion and control science and technology can prove counter productive and may even run contrary to the above mentioned national goals of realizing human rights and satisfying basic human needs, in relation to national socio-economic development ..... Science and technology are an integral part of modern culture. Therefore, in the design of successful science and technology programmes consideration should be given to local cultural patterns and values in order to make such programmes acceptable and understandable to the community. Scientists and other professionals involved in science and technology, whether it be in the education or the application thereof, should not under-estimate current local practices. Old and traditional practices are not necessarily bad or inefficient. As a sound approach, an inventory of these practices should be made, identification of advantages and disadvantages, particularly regarding needed inputs, and alternative solutions worked out, and tested.'

The development of science and technology and their promotion through education will playa vital role in solving the most urgent problems confronting us, since these problems threaten the conditions and quality of life of vast sectors of the population and their very survival.

THE TEACHER

The teacher, at all levels and all disciplines, plays a very important role in national advancement. While the influence of the parents is supreme during childhood, as the child advances, he or She is open to the influence of the school, the teacher and the school mates. Shri Avinashalinqam. former Education Minister of Tamil Nadu and Director, Shri Ramakrishna Mission Vidyalaya, Coimbatore, in his book entitled 'Educational Philosophy of Swami Vivekananda' observes:

'The teacher is the pivot on which any educational system revolves. The best scheme of education can become bad, if the teachers handling it are bad. The quality of any educational system depends to a large measure on securing well-educated and well-equipped teachers, steeped in learning, strong in character, with high ideals, and devoted to the spread of knowledge. If ancient India was a great seat of pilgrimage and learning and men from far off countries came to her, facing tremendous difficulties, it was because there were masters who regarded the pursuit of knowledge and truth as the greatest thing in their lives. They were eminent not only intellectually but also were spiritual lamps, who lighted the light in other souls.'

Today citizenship concept has to be instilled into our youth in all its wide bearings. not only in its political bearing. which is what we seem to understand in India. Boys and girls grow up year by year and when they reach a certain age they become citizens automatically. That is all the youth is made to be aware about citizenship. But there are educational principles. practices and techniques by which a child is made fit for the citizenship ideal. capable of bearing the responsibilities and burden of society even at the age of 18. The sense of responsibility increases the spiritual nature of man and makes him or her mature in a socio-political sense. If there is one thing which we have lost in India since we attained independence it is this maturity and its fruit the sense of responsibility.

Teachers at all stages. from nursery to post-graduate should emphasize the above to youngsters in addition to their academic or technical teaching. Furthermore. the teacher should try and follow these precepts so that he sets an example to the students by his own actions and thoughts. There is no use in telling the youth: Do as I say but don't do as I do.

NATIONAL CHARACTER

For the first time in the history of the world. Mahathma Gandhi has proved that a country's freedom could be won through moral and spiritual means. After attaining freedom the scramble for power has swung the pendulum to the other extreme. This has resulted in lowering the national character to such a great extent that our standards of social conduct and administration cannot now be considered high. If we are to continue as a great nation. we have to urgently stem this tide of deterioration.

In the memories of his working life, Dr M Visvesvaraya wrote:

'The way to build a better nation is to build better individuals. A successful nation is usually composed of citizens. the majority of whom are efficient, of good character, and possess a reasonable high sense of duty. An individual who aspires to be trusted should have character. The foundation of business, as we know it, is credit. Credit depends upon confidence .....'

'Foreign nations cannot be expected to advise Indians how to develop into an efficient nation. Both the Government and national leaders should assume this responsibility of building a good national character, progressive behaviour and corresponding welcome habits in the population.'

'The development of a good national character should form one of the country's long range policies. This policy should be encouraged by every citizen who wishes to see the Indian Nation rise to a position of esteem for efficiency and high character amongst the nations of the world.'

These words were written by that great son of India more than 35 years back and his words are even more relevant for India at the present juncture. We as elders and parents should set an example by our action for the youth to follow.

OUR INSTITUTION AND NATIONAL ADVANCEMENT

Over the past 65 years the Institution of Engineers has been serving in the development of our country in various ways. In order to facilitate more members to actively participate and in conformity with the principle of decentralization, we have set up a nationwide infrastructure through our State Centres, Local Centres, Sub-Centres and Paper Centres spread all over the country. There are also students' chapters and technicians' chapters set up in colleges, polytechnics and other institutions. The National Design and Research Forum (NDRF) at Bangalore, the Rural Development Forum (RDF) near Calcutta, the Extra High Voltage Forum (EHVF) at Bombay, an International Activity Centre at New Delhi that have been set up is indicative of our urge to serve in specialized fields. The Engineering Staff College, established at Hyderabad, caters to the very important need of keeping our engineers up to date in various disciplines by special short-term programmes and continuing education courses. Our well established and accredited examinations conducted twice a year, cater to a very large number of young men and women who are anxious to qualify themselves as engineers and play their role In the advancement of our country. It is in facts non-formal open technological university. The Committee for Advancement of Technology and Engineering (CATE) which meets frequently enables discussions in depth on many problems of national importance. The Institution is the largest multidisciplinary professional body In the world. We have bilateral agreements with a number of outside professional bodies and have been hosting a number of International Congresses on behalf of India. The Institution is also serving as National Committee or National Member for a number of world professional bodies.

Yes, we have all this and more. On this occasion I would like each one of us to ask ourselves if we are putting forth our best for our country through our Institution. As we try to do more. there are bound to be new problems which we have to solve by mutual exchange of views and discussions. I have full confidence that our members, particularly the younger members, will learn from the mistakes that we, the elders, have perhaps committed in the past, and rise to the occasion and help in building up a nation which can not only hold its head high amongst the nations of the world but also give them a lead.

CONCLUSION

I have immense faith in our youth, and l want them to ponder over an old saying : 'It is not what you have that matters. but it is what you do with what you have, that a really matters and act accordingly.

I wish to conclude by recalling the words of two great sons of our country. Pandit Jawaharlal Nehru exhorted the nation, on the eve of Independence, thus:

'The future is not one of ease of resting but of incessant striving so that we may fulfil the pledges we have so often taken, The service of India is the service of millions who suffer. It means the ending of poverty and ignorance and disease and inequality of opportunity. The ambition of the greatest man of our generation, Mahathma Gandhi, has been to wipe every tear from every eye. That may be beyond us, but as long as there are tears and suffering, so long our work will not be over. And so We have to labour and to work and work hard to give reality to our dreams.'

Our Engineer-Statesman Dr M Visvesvaraya showed his greatness and humility, when replying to the felicitations offered to him on his 91st birthday when he remarked: 'I thank you for taking note of the insignificant act of my birthday......

When we requested him for a message to the students and staff of the College of Engineering, Bangalore, on the same occasion, he said: 'Draw a straight line of conduct and follow it irrespective of the crooked ways of others.'

May the Divine Grace give us strength to follow the above ideals and bring prosperity to the country, through development in which every citizen will have a role.

Thank you.

Prof B R Narayana Iyengar—a Brief Profile

Prof B R Narayana Iyengar, B Sc, BE, SM (MIT), FIE, a distinguished mechanical engineer, an eminent educationist, a reputed scholar and researcher and an acknowledged authority in the fields of machine design and boiler technology, who has been honoured with many coveted national and international awards for his outstanding contributions to engineering has been unanimously elected President of the Institution of Engineers (India) for the session 1986-87. He will take over this high office from Shri C R Alimchandani, retiring President, at the 66th Annual Convention to be held at Ahmedabad on January 12, 1986.

His score of academic attainments is both profuse and brilliant. He took his B Sc degree (Physics) in 1929 from the Central College, Bangalore, securing a First Class, and BE degree (Mechanical) in 1933 standing first in First Class from the University College of Engineering (now renamed University Visvesvaraya College of Engineering), Bangalore. Throughout the engineering course, he was recipient of merit scholarships, comprising the Bowen memorial, the V R Iyengar Memorial and the GA Murthy Prizes. After a period of apprenticeship, he was appointed Lecturer in Mechanical Engineering at the College of Engineering, Bangalore.

His first professional job was with the Government Test House (now National Test House), Alipore, Calcutta, as Technical Assistant after being selected by the then Federal Public Service Commission. He was placed in charge of testing various stores for the Railways, Indian Stores Department and Defence Department. He was also responsible for drawing up several specifications for other industrial organizations.

Prof Narayana Iyengar has distinguished himself as an engineering academician and educationist of repute. In 1942, he was appointed Assistant Professor of Mechanical Engineering at the University College of Engineering, Bangalore. In 1947, he was awarded the Mysore Government Scholarship for higher studies in the USA at the Massachusett Institute of Technology (MIT) and secured a Master's degree with distinctions. He visited a number of American Universities as well as several large industries before he returned to India in 1949. He was promoted as Professor and later he took over as Principal of the University College of Engineering, Bangalore. He retired from the University services in 1965. He then joined the Mysore Technical Education Society as Principal of the Mysore Engineering Institute and later as Director of Studies in which capacity he still continues.

During his long period of service in the University of Mysore, he has been instrumental in effecting a number of noteworthy improvements in different fields of engineering education and research in the erstwhile Mysore State. He was Chairman of the Board of Studies in Mechanical Engineering, Dean of Faculty of Engineering, Member of the Academic Council and the Senate for a number of years. He has also been associated with the setting up of technical institutions, their affiliation and monitoring their growth not only in Karnataka but also in several other states. He is connected with a large number of universities in India on their examination boards and academic bodies both under-graduate and post-graduate studies such as Osrnania, Kerala, Madras, Andhra, Rajasthan, Banaras, Jabalpur, Annamalai, Pune, Utkal, Karnataka, Mysore, Bangalore, Punjab, Sangar, Roorkee, Baroda, Sri Venkateswara, Vallabh Vidyanagar and several IITs.

He has been on the staff selection committee of a large number of colleges, technical institutions, IIT's, IISc, Regional Engineering Colleges, Defence Research Development Organisation, CSIR laboratories and others. He has been connected for a long period with the Union Public Service Commission as Examiner and Adviser and has been associated with the restructuring of the Indian Administrative Service and other examinations.

As a member of the five-man delegation set up by the Government of India to study the system of higher technical education in the USSR, he has visited a number of higher technical institutions in that country and familiarized, himself with the advancements there by discussions with eminent academicians.

An eminent authority in the field of machine design. Prof Narayana Iyengar is also the joint author of a book entitled 'Machine Design Data Handbook,' the first of its kind published in the country. He has several technical papers to his credit. His recent paper on 'Training of Technicians' was presented at the International Conference of Scientific Unions (ICSU) sponsored by the UNESCO *held at Bangalore in August 1985.*

He was a committee member of the Association of Principals of Technical Institutes (now ISTE) and Member of the Southern Regional Committee of the All India Council of Technical Education (AICTE) over a number of years. He was on the Governing Council of the Technical Teachers Training Institute. Madras. He has been a member of the Kamataka State Board of Technical Education and the representative of the Institution of Engineers (India) with the Directorate of Employment & Training. He has also served as member of the All-India Technicians Board.

Prof Iyengar was largely responsible in framing the rules for the Boiler Attendants Examination Board, Karnataka, and served as its member for a number of years. He was also member of the Panel of Assessors in the Appellate Authority constituted under the Mysore Boiler Rules by the Government of Mysore for the old Mysore and the integrated areas from Bombay, Madras and Hyderabad.

Prof Narayana Iyengar's association with the Institution spans a period of over four decades. He joined it as Student and was elected as Associate Member in 1945 and, Fellow in 1972. He has been on the Executive Committee of the Karnataka State Centre for over 30 years and was Joint Honorary Secretary and later Chairman for two years. He has been on the National Council of the Institution for a number of years and has served as Chairman of the Mechanical Engineering Division Board, Group Chairman of Machine Design Group, and member of the Examinations Committee and Finance Committee. He has been very closely associated with the framing of the rules and syllabii for the new Diploma Stream as the Chief Coordinator. He has also been an examiner for Sections A and B Examinations for several years.

For services rendered to the cause of technical education, he was honoured by the MEI Polytechnic at their Silver Jubilee in 1983_ He was also honoured by the Karnataka State Centre of the Institution of Engineers (India) at their Golden Jubilee in 1984 in recognition of his leadership and guidance as an eminent fellow engineer.

A keen promoter and lover of sports, he has been an outstanding sportsman in his cgllege days having won several championships in tennis and represented his college in inter-collegiate tennis, basketball, etc. He was Vice-President of the Mysore State Lawn Tennis Association, member of the committee of Mysore Hockey Association, Vice-President, Mysore State Basket Ball Association, and is at present Vice-President of the Committee of the Karnataka State Kho-Kho Association. He was Chairman of the Physical Education Re-organization Committee of the Mysore University, Chairman of Mysore University Sports Committee as well as the Bangalore University Sports Committee and presently is on the Advisory Board of Physical Education of the Bangalore University. In recognition of the services rendered to the cause of sports, he has been awarded the State Sports Award at the Dasara Celebrations, 1984. He received training as Rover Scout, and undertook the University Officers Training Course (UOTC).

An eminent personality in the engineering profession, with profound dedication to the cause of progress and advancement of his fellow engineers, Prof Narayana Iyengar brings a new awakening to the Institution. His election as President of this federal body of engineers is sure to make the profession stronger and enable it to contribute better service for the welfare of the nation. The Institution fervently looks forward to his enlightened leadership, guidance and support in its efforts to serve the profession and the country at large.

Prof Dr Satish Chandra

President 1987-88

Presidential Address

यद्यदाचरति श्रेष्ठस्तत्तदेवेतरो जनः ।
स यत्प्रमाणं कुरुते लोकस्तदनुवर्तते ।।
—श्रीमद् भगवद् गीता 3/21

For whatsoever a great man does, that very thing other men also do; whatever standard he sets up, the generality of men follow the same.

(Shrimad Bhagvad Geeta)

I am extremely grateful to the National Council of the Institution of Engineers (India) and to the engineer brothers whom the National Council represents, for the great honour they have done to me by electing me the President of this great body of engineers and technologists. I am deeply concerned with the heavy responsibilities that are coupled with this trust and honour and | shall do my best to come up to their expectations and to justify the confidence that has been reposed in me.

I also thank my predecessors for the excellent work done by them to bring the Institution to the present status; and I assure them, the National Council and the entire engineering fraternity of the country that it will be my endeavour to do my best for furthering the cause of the Institution. | look forward to the active assistance and continued cooperation of my colleagues in the Council so that together we may strive as a team and add yet another year of achievement to the onward march of this great institution.

We are deeply grateful to our Hon'bie Prime Minister for graciously responding to the invitation of the Institution to inaugurate the First Engineering Congress, notwithstanding his preoccupations and the pressure on his time. It speaks of the recognition of the role of our Institution and the importance of engineers in the development and progress of the country. This also means that he has high expectations from us all. We are aware of our obligations and he would not find us wanting in our services to society and the country. By being here with us today, he honours the Institution of Engineers as well as all the engineers and technologists of the country.

We are also indebted to the Hon'ble Governor and the Chief Minister of West Bengal for being with us today to preside over the inaugural function and also to the distinguished guests for their presence.

THE INSTITUTION

The Institution, established in 1920 and granted the Royal Charter in 1935, has pursued its objectives to promote advancement of engineering and engineering sciences and to disseminate adequate knowledge and has contributed to the development and prosperity of the nation. The Institution membership exceeds 280000 out of which 55000 are corporate members and the balance student members. The membership of the Institution carries with it the pride of the profession and has played a significant role in harnessing the natural resources with ceaseless efforts contributed to the development of technology. The Institution has 64 centres located on geographical basis at the state capitals and engineering and industrial complexes all over the country. It also operates five overseas chapters and has established links with the engineering societies of the countries where these chapters are located.

The Institution has set up and is in the process of establishing bilateral agreements for technical cooperation with similar institutions in 14 countries. It is also interacting with the engineering societies of neighbouring countries—Bangladesh, Nepal, Pakistan and Srilanka— under the banner of the Federation of Institutions of Engineers of South and Central Asia (FIESCA).

It is the premier national organization of engineers, discipline-wise most comprehensive and has 15 divisions operational covering various disciplines of engineering. Different branches of engineering have become so much interdependent that growth of one helps the growth of the other and engineers specialized in one branch must know what developments are taking place in the other. Keeping this in view, the Institution has continued to play its role vital to all branches of engineering.

For updating the knowledge of professionals, the Institution publishes technical journals in 15 and conducts disciplines technical lectures, continuing education courses, seminars and symposia through its centres. The Institution also invites international technical congresses ta the country so that Indian engineers can interact with the foreign engineers for exchange of experiences and achievements.

Continuing education is an essential activity of any educational system more so in case of technical education. It is said that engineering is a 'learning' profession rather than a 'learned' profession. For India to achieve the status of a developed country, there is a need for trained technical manpower. The Institution of Engineers has been performing the role of an open technical university, the largest in the country, for the benefit of those who cannot make a mark of entering professional colleges or the university. Over 200000 young members of the Institution are taking up the Institution examinations to improve their qualifications leading to a degree in engineering. The entire system of conducting the examinations like coding, tabulation of results and grading is done through a computer in the Institution in addition to the maintenance of membership record and to some extent the maintenance of accounts.

It is continually improving the curricula to the desired standard and at par with that in the established institutions of technology and engineering.

The Institution has also started an Engineering Staff College at Hyderabad for providing training to in-service engineers by conducting specialist courses.

Other important functions of the Institution include the responsibility of accreditation of engineering institutions and the right for its corporate members to affix the title of chartered engineer and to practice as professional engineer bound by a code of ethics laid down by the Charter. The institution is still working under the Royal Charter which needs to be amended by an Act of Parliament so that this national body is fully responsible and can serve the nation in an effective manner for all facets of engineering covering academic and professional boundaries. It is, therefore, imperative that an engineers' bill be drafted by the Government in consultation with the Institution of Engineers (India) which is the sole organization bestowed with charted engineership in the country.

Besides the mainstream of its regular activities, the Institution also performs some associated functions to which it attaches considerable importance. One of these is the establishment of Forums covering areas of specialization connected with engineering. These are: the National Design and Research Forum (NDAF), the Rural Development Forum (RDF) and Water Management Forum (WMF). The Design and Research Forum is located at Bangalore to coordinate valuable research findings to encourage engineering design talent through competitions and to provide library and documentation services. The Rural Development Forum is located at south Jagaddal (off Calcutta) to develop, inculcate, transfer, apply and adopt technology in appropriate way for rural uplift socially, economically and vocationally. The Water Management Forum has recently been established at Ahmedabad for the purposes of investigating and promoting judicious use and management of water resources.

The Institution plays a very important role in providing interaction of young engineers with senior engineers, who have excelled in the profession by their outstanding capabilities, in establishing them as specialists of tomorrow and tackle the complex problems that they may face thus transferring their knowledge and experience to posterity.

The activities of the Institution in all its political and economical implications by and large remains unknown to members of Parliament, members of the state legislators, the Union and State Governments and the public at large. It is high time that we wake up to these realities and strengthen our public relations so as to comprehensively cover industrial employers, the Union and State Governments, the legislators and the press.

One this occasion, I would like to share with you some of my thoughts relating to the role of engineers in national development and some of the areas which need special attention for taking the country with confidence into the 24st century.

WATER RESOURCES

We are very fortunate that Pandit Jawaharlal Nehru realized the importance of river valley development and initiated the construction of large projects. These projects were completed in good time and have yielded considerable benefits to the agriculture and industrial economy of India. Sm Indira Gandhi, on river valley development said, 'Let us think not so much of what we have done but of what we have left undone. Let us think about the mighty resources of India, which, if harnessed and utilized for common goad, can change the face of India and make her great and prosperous. To this great task let us address ourselves with all the strength in us.'

As per Planning Commission's projections, if the population by 2030 AD would be contained at 1121 millions, we would require production of 277 Mt of food grains. For this, greater emphasis has to be laid on higher agricultural growth.

The available water resources using present practices will not be able to provide this agricultural growth. Therefore, water has to be used more efficiently. The present water use efficiency of 25%-30% has to be increased to at least 60% or even higher. In areas with limited water availability such as Haryana and Rajasthan, efficient water use measures of sprinkler and drip irrigation having an efficiency of 85% -90% are required. In a broadcast to the nation in January 1982, Sm Indira Gandhi said, 'We must get more under every acre ploughed, out of every spindle and machine, out of every technologist and worker, out of every rupee spent'.

With increasing realization of the need of water conservation and optimal use, the irrigation manager has to change the irrigation scheduling based on monitoring soil moisture variation according to crop demand.

There are two problems relating to water which the country has been facing quite frequently and has been playing on our resources. One of them is flood and the other is drought. Many states have been affected by floods causing loss of human life, cattle, crops and property. Recently the country faced acute flood problem in Andhra Pradesh and West Bengal besides many other states, and considerable resources have to be provided to the states for flood relief. Despite the massive investment made on flood control measures, the damage to life and property has been increasing due to increased encroachment on the flood plain which goes uncontrolled. It calls for undertaking non-structural measures such as flood plain zoning and flood forecasting. There is an urgent need to prepare flood plain zone maps for river basins and, in high risk zones the States may take up legislation to check encroachment by suitably adopting the model bill made available by the Central Government. For issue of flood warning to the people located in flood plain, flood forecasting activity has to be extended. Mare flood forecasting stations should be established in river basins and efficient methods of communication of information from remote sites to the central stations need to be developed. To reduce the flood damange, the possibility of conserving flood water to provide underground storage need to be examined.

The drought of 1979, 1981 and the continuous drought from 1984 to 1986 has adversely affected over 44 Mha of crop area, 1213 millions of cattle population and 149 millions of human population spread aver 14 states and union territories. Resources are being provided to the states as central assistance as a relief to the people affected. There is a need to have a planned effort for drought preparedness and drought management by managing the ware efficiently in the affected area. If a review of water availability (surface and ground water) is made at the end of October each year, the areas which are likely to have water scarcity can be identified and advance action on measures of drought proofing and drought management can be taken and available water allocated judiciously for various uses. In such situations water supply for human and cattle consumption and fodder production would get priority over crop needs. Depending upon the water available for crops, the type of crops to be sown can be decided and implemented. Besides this, water conservation measures, and provision of non-agricultural employment through development of small scale industries for the population likely to be affected has to be resorted to.

Adequate attention has not been given to data collection in the states. There is a need to create agencies which can continuously collect data on a long-term basis and develop an appropriate data storage, analysis and retrieval systems. Quite often, we are obliged to base our design on insufficient data. States should, therefore, improve the data sets so that development projects could be prepared with confidence. Along with data collection, investigation should also start very much ahead of the sanction of the projects. We must plan for the posterity right from now.

In recent years, we have been experiencing difficulty to take up new projects since they have to be examined for their adverse effects on the environment. The engineers should be receptive to the suggestions of environmentalists and analyze them in proper perspective and examine the projects proposed from positive and negative aspects to enable taking up suitable decisions in the overall interest of the country.

The rivers act like the nervous system of the nation. Water is being diverted for useful purposes to the humanity. From historic dates civilizations have developed on the banks of the great rivers but disappeared in course of time either due to drought or high contamination in these rivers.

गंगेच यमुने कृष्णे गोदावरि सरस्वति ।
नर्मदे सिंधु कावेरि जलेस्मिन् सन्निधि कुरु ।।

This sloka clearly reflects the sacredness of the rivers and the importance attached for keeping them clean. With the population explosion and rapid industrialization, it has become necessary that enough attention has to be given to keep these rivers clean and free from pollution.

The Government of India, realizing this importance, has already initiated action by establishing the Ganga Authority and purifiction of the river Ganga has started.

The watersheds are not being managed properly resulting in deforestation and land degradation besides the adverse effects on the fauna of the region leaving an impact on socio-economic conditions. Mathematical models have to be developed and used for watershed resources management, integrating the resources of land, water, flora and fauna by understanding the interrelationship and inter-dependence of these resources and . to arrive at a planned growth and for sustained yield of watershed resources. This integration can help in optimal development of the water resources, forest and other resources without any detrimental effect on the environment.

ALTERNATE SOURCES OF ENERGY AND ENERGY CONSERVATION

Energy consumption reflects the status of a country's economic growth. With the present rate of energy demand, the country will not be able to provide the requirement of energy from non-renewable sources for the next century. Alternative renewable sources if developed will not have any impact on the environment. We, as engineers, have to find out the technology to provide cheap, alternative and renewable sources of energy which can put the country on sound footing in the industrial sector and the hazards of industrial growth are minimized. To quote the words of Smt Indira Gandhi, 'Time has come when greater emphasis should be laid on deriving energy from the sun, wind and water.' We must now make urgent and all-out scientific efforts to promote the utilization of solar and other resources of renewable energy which incidentally also help in safeguarding the environment. Emphasis has to be placed on hydro power development which includes major, mini- and micro-hydel. stations. Against an estimated potential of 75 GOO MW, the present rate of generation is only 20%. We have necessary technical know-how in the country which makes it possible to develop hydro power even under most complex geological conditions. Efforts have to be made to harness more hydro-electric potential. It is not just adequate to harness the potential but optimal and efficient utilization of energy thus harnessed is necessary. There is a need for energy conservation in the industrial sector. Over the years, Japan has reduced its energy consumption in industrial sector by more than 30%. If determined efforts are made even in our country, energy conservation to the extent of 20%-25% can be effected. This calls for introduction of new techniques like mechanical innovations to reduce energy consumption.

RURAL DEVELOPMENT

It is really saddening that we could do very little for the rural masses. The rural people are migrating to the cities in search of alivelihood. This influx of rural population towards cities is playing upon the development activity of urban areas which are always lagging behind development and as such we see around people of urban areas living in miserable conditions.

Development in rural sector is needed to check this migration of population to cities by providing them adequate means and amenities. The approach to such development is a comprehensive one in which integrated development projects are to be taken up to overcome the difficulties experienced including the problems of farm tenents. Rural engineering has a vital role in the national -economy since in the rural section alone reflects the true India.

A variety of agencies have come into being and are engaged in rural development projects. These include government agencies and voluntary organizations. They are trying to do good to the poor and under-privileged sections of the rural community. However, these programmes and projects have not been able to make a marked impact nor generated sufficient enthusiasm and sense of participation in the people concerned.

The development programmes should basically relate to the socio and cultural understanding of the people. These programmes should not just aim at creating employment opportunities but creat efficient productive employment. The programmes should include the economic and technological aspects and the two must be closely integrated with each other.

The first step in this direction would be to retain the talented rural manpower in the rural areas by devising ar economic activity which is both gainful and satisfying. One of the surest ways to develop rural employment seems to lie with rural industries which can be developed according to the social needs, availability of raw materials and resources. In the villages one has to work out a technology which can create an interest amongst the rural masses, which must be simple and easily workable. The technology suited to local conditions has to be applied and infrastructure support such as training for better and effective use of the skills be provided.

The complexity of rural development poses a challenge to the engineering profession in responding to the needs of the rural people. The role of retired engineers in view of their extensive experience in evolving measures in guiding the rural people need not be over-stressed.

I am sure, the engineers will not lag behind in this accepting challenge and handle the situation with confidence and competence. it is necessary that the Institution of Engineers with the guidance and involvement of engineers from different centres should be able to offer solutions to the problems faced by villagers. We should extend all support to the Prime Minister and work to our fullest might for the betterment of the people.

URBAN DEVELOPMENT

This does not mean that the development achieved in the urban sector is also too far from satisfaction. A lot has been done but a lot more need to be done. In long-term planning based on forecast of needs, as also in the entire process of urban planning, the role of engineers is very vital, as they provide to the communities much needed facilities. Our urban centres are becoming areas of unhabitable space and chaotic living conditions characterized by unhygienic situations. There is a need to have rapid and significant change in the whole outlook towards planning and development and the application of intuitive methods of formulating urban development programmes. For the future planning of the urban centres, one should consider all engineering aspects along with physical, social and economic determinants and environmental considerations and cost factors.

The engineers should establish the correlation between local urban development practices, engineering construction programmes, overall costs and general outline of development programmes. At the same time, there is a growing need for intense continued effort for improvement of civil engineering practices in the area of technology and associated urban facilities.

PROCESS INDUSTRIES

The chemical and other process industries have to be given a boost for the development of the economy. Some of the chemicals of great importance are fertilizers, petrochemicals, heavy chemicals, pesticides/agro-chemicals and polymers. In order to bring India at par with developed nations, we have ta develop technologies at par with their technologies. It is important that our designers, research and design organizations, consultants and government agencies should come forward to help chemical and other process industries. These chemical plants have to be energy-efficient and pollution free to make our environment neat and clean for the people to live in.

Unfortunately, most of the chemical industries have fallen into red category of industries, as per the requirement of the Environment Protection Act 1986. Not only the growth of chemical industries has to be speeded up but it has to be planned in such a manner that future development is compatible with the environment and energy efficient. For this purpose, models for the ambient air quality are to be generated for all important industrial areas using microclimatological data. It will also be important to predict water quality for all the liquid waste receiving systems so that complete environmental assessment of existing and future industries are made available to help planning environmental compatible growth of these industries.

COMPUTERIZATION

Computer is becoming a fast indispensable tool for engineers. The engineers must adapt themselves to the new generation of computers. Computers find wide variety of applications besides scientific processing, like carrying out administrative and financial functions for ensuring the right information at the right place or making correct and sensible decisions. This will result in increased industrial productivity. Computer controlled robots with built-in intelligence provide a degree of flexibility not available in traditional automation. The range of application of computers is perhaps listless. Each day heralds a new application. Problems which were beyond human comprehension are now solvable, whereas, on the other hand, more challenging frontiers of science and technology are being harnessed. The structural planning and testing with the aid of models for any type of construction whether it is in building construction or aeronautical engineering has become possible. There is hardly any sphere of life or society which has not been invaded by computers. Computers are in fact the catalysts in national development and social change. They are synonymous with productivity. Role of computers in information processing and personal management cannot be under-estimated. Decisions through computers can enhance productivity and profitability. A very recent example has been the introduction of magnetic ink character recognition (MICR) information handling by the Reserve Bank of India.

On the other front, the invasion of personal computers at home and in small business establishments has changed the whole scene. The slide rule, one time companion of engineers, is a rare entity. Use of word processing, office automation, teleconference concepts have given an altogether new dimension to the function and management of the small business as well as the corporate world.

In the national perspective, resource management assumes greater significance in view of our limited resources and the only way their utilization can be optimized is to take recourse to computers. With the confluence of technical brain power and the computation at speed of computers, we can solve our most complex problems of optimal resources planning and management.

DEVELOPMENT OF TECHNICAL MANPOWER

Development is the development of people's creative and innovative ability, enterprising attitudes confidence and self-reliance. This should enable them to get gainful employment and capacity to stand on their own legs. On the technical education front, India has been successful in setting up a large number of institutions, most of these have excellent facilities. However, the impact of graduates passing out has not been substantial. The possible reasons are that curricula not in tune with the industrial needs and lack of interaction with the industry. It is often said that the engineering graduates find it difficult to apply their theoretical knowledge to real life environment. Industry and institutions should sit together and design a comprehensive package so that technical institutions are sensitive to developments and needs of the industry and the curricula achieve a balance between theory and practice. The government has recently drawn up a national education policy which, I hope, when implemented, will be able to take care of these considerations and also develop a self-reliant manpower ready to take over entrepreneurship to bear the burden of the development process.

A mechanism has to be developed that university professors visit industries for extended periods and gain understanding of industrial problems and senior engineers and technologists working in industry spend a semester or so at the technical colleges to interact in the training programmes and speak to students about industrial functioning and mechanism of handling industrial problems. The industries should take the lead in this matter and support these programmes by adopting institutions for twinning arrangement and must provide the best of their men for interaction in the interest of long term benefit to them and to the nation at large. Only a concerted effort on the part of government and industry can change the course of events. This will not only help the training of engineers but also provide interaction in research and development.

Another aspect needing attention is the development of managerial cadre at middle and top level engineers. With good technical background and knowledge of industry, the engineer will make the best industrial administrator and manager after proper training. Industrial management training programmes should be enlarged to include finance, administration, production management, marketing management, material management and personnel management including R&D needs. Besides the development of additional facilities by Government and industry, the Engineering Staff College of the Institution should also take up this as an important activity to achieve the desired results.

RESEARCH AND DEVELOPMENT

The development of science and technology owes a lot to the vision of Pandit Jawaharlal Nehru. This has been given no less attention by subsequent Prime Ministers including our dynamic Prime Minister, Shri Rajivji. Over the years a chain of laboratories have been built and were nurtured by providing a climate of trust, confidence and freedom. The technology policy of 1984 also highlights the government's concern and the measures needed to bring about the necessary transformation.

In spite of all this, the country could not make any breakthrough in R & D, while many countries which are much smaller in size and with lesser technical manpower have been able to make substantial contributions. Japan, an importer of steel in the earlier decades of the century and wholly dependent on imported raw materials, is the possessor of most modern technologies. South Korea, which established its steel industry much later than India, has emerged as one of the big producers of steel in the world, giving keen competition even to the developed countries. It is high time that a correct diagnosis is attempted for this slackness in the field of research and development and identify atleast the areas which require immediate attention. With the limited resources that the country has at its disposal, we should identify the priority areas so that the investment can yield good results.

The country has not yet mastered technology management. The countries which have realized the importance of technology management are able to make progress in attainment of technology self-reliance. India only now has realized the difference between science and technology and as such, I hope it would achieve reasonable level of technology self-reliance.

Efforts have to be directed towards efficient absorption and adaptation of imported technology besides R&D efforts to develop new technology. Whatever superior technology has to be imported, it must take root in the country in order to be of real use.

Due to lack of linkages between industry and research and development organizations, the country could not effectively use the available capabilities. It is necessary that results of R & D should be able to increase industrial output and in turn the industries should indicate their requirements to the R&D organizations. This will facilitate reduction of import of technology.

Whenever the 'know-how' has to be imported, the industry must involve its corporate R & D and other R&D organizations working in that area, for building up rapport and for subsequent development. in case a consultant is invited from abroad for solving a problem, Indian R & D should interact with him so that the 'know-why'' can be understood. Only then confidence will develop in the Indian R & D community and in the tong run they can contribute effectively. The initiative to start this dialogue between R&D institutions and industry should necessarily be from the industry. A methodology for developing such interaction has to be evolved for motivating industry either by persuation or by concealed compulsion or by incentives.

Technology transfer is needed both horizontally and vertically. Vertical transfer is import of relevant technology from a developed country and should be availed of in frontier areas only. R&D efforts within the country have to be linked up with such import of 'know-how' envisaged in the socio-economic framework of plans.

On the horizontal transfer within the country, the technology has to flow from R&D organizations to people at large, by developing an effective system of transferring the rapidly growing and accumulating technical information. The data around us has to be effectively processed, stored and rapidly disseminated by simulating and demands. This can be achieved through: (a) training programmes, (b) information retrieval systems, and (c) strategy of technology adaptation.

ENGINEERS' OBLIGATION TO SOCIETY

An engineer is a creative person and an effective agent who can bring out the change in the living standards of the people by delivering the fruits of research and technological development to society. An engineer's systematic and professional training and knowledge can solve a whole range of problems. Delivering the convocation address at Roorkee University in 1967, Prime Minister Indira Gandhi highlighted the following points:

(i) Contribution of technology to the task of transforming the economy
(ii) Administrative environment in which engineers and scientists can best service the country
(iii) The contribution of technology and science towards changing social attitudes
(iv) Relationship between the state of technology within our country and in the wider world

The engineers all over the world as also in India have made major contributions in bringing about scientific and technological breakthrough for the benefit of society. Indian engineers have achieved international standards and eminence in various fields. However, we cannot be complacent.

National reconstruction demanded construction of huge buildings and multistoreyed structures for Government for office buildings and other purposes; new highways with incidental bridges, causeways and other crossings; industrial townships and factories; capital city construction, providing drinking water facilities and other basic amenities. The engineering type of mind is so much needed today to assist in solving these current complex problems by cool, rational analysis and sound judgment.

The engineer should always strain every nerve for bettering his professional attainment, but never at the cost of social and political segregation. He must assert his rightful place in society and an instrument in the effective shaping of the policies of the country and to the building of which he contributes so much.

The texture of economy and culture are rapidly changing as a result of frequent technological improvements. Mankind is going through another scientific and technological revolution—automation, satellite communication, Computerization, microprocessor applications, remote sensing techniques—to name only a few which are already widely applied and which hold the key for future social and economic well-being of mankind at large and specially those in the lesser developed countries like India. We, in India, would have to work with redoubled vigour to reduce the technological gap with other countries. This is possible only when we take the common man into confidence at all stages of our activities and educate him into the why and wherefore of bond of kinship in our creative endeavour and prepare himself for utilizing the fruits of that endeavour.

It is most essential that we have to exercise a more effective voice in the administration of the country and bring to bear on the administration our special attributes of precise thinking, balanced sense of values, organizational skill, understanding of human psychology and above all the tenacity of purpose in the achievement of the objective. No longer should we be content to be represented by intermediaries outside our own profession. Through creative effort, ceaseless application and selfless devotion to duty, we should move steadily but surely forward in our noble task of building up a New India.

The mere fact that a person has acquired a bachelor's degree in engineering does not in itself entitle him to any individual lasting recognition. It remains for each individual to prove by his own ability, integrity, and conscientious application to duty that he deserves recognition. It is impossible to maintain professional integrity without social integrity; the two supplement and complement each other.

In the present day technological world, in order to accomplish the task before us, the engineers must develop themselves which will fit them for managerial responsibilities. Once it is realized that rapid development and high productivity are vital for our socialistic society, technical men would be required for management and administration of public and private sectors, there is an obvious urgent need to make use of technically gifted men for top management of these organizations.

A large number of measures have been initiated under the new 20-Point Programme with the objective of taking the country with confidence into the 21st century. The engineering community has a positive role to play towards this end.

Recently, we have celebrated the 'Quality Month' in November 1986. Way back in March 1985, Prime Minister Rajiv Gandhi remarked,' Quality of our products really leaves very much to be desired. We are selling to a market which is not responsive to quality. The industry will have to change faster and will have to make the market change.'

A culture of quality is to be developed by the engineers and technocrats if India is to achieve recognition in the international market which is so vital for economic development and growth of India. They have a vital role to play in speeding up the development of the society and the nation. This calls for a quantum leap in science and technology.

All of us are confronted with the challenge of achieving technical perfection to be able to assist in improvement human life. We must try to assume responsibility, too, for the ethical and physiological aspects involved in application of technology.

There was a time when development was measured by growth of GNP. industrialization and growth of industries alone were considered as signs of advancement. But now quality and improvement of life should have emphasis rather than quantitative growth of the economy.

In this vast country, we have a mighty responsive manpower, unending industrial resources, a proud heritage, and the bold and imaginative leadership which is working on a 20-Point Programme for the nation's economic recovery and growth. Engineers and technologists can harness out of this potential whatever is needed or societal cause, particularly, for those sections of our people who have suffered for ages and desperately need a new way of life. Let them have confidence in us and let us have confidence in them.

With this conviction and avowed faith that engineering has a great lot to contribute to our continuing battle to rise our national status and prestige, let us pledge with all dedication, that we will serve with our total strength at all times and on all occasions help the government in its relentless diverse endeavour to serve the people of this great country.

JAI HIND

Dr Satish Chandra — a Brief Profile

Dr Satish Chandra, BSc, BE, DHE (Delft), PhD, FIE, an eminent educationist and research worker, a distinguished civil engineer and consultant with an internationally acknowledged authority over hydrology and water resources, has been honoured for his outstanding achievements in education, research and contributions to engineering, by electing him as the President of The Institution of Engineers (India) for the Session 1987-88. He will take over this high office from Prof B R Narayana Iyengar, retiring President at the first Indian Engineering Congress to be held at Calcutta on January 10, 1987.

Dr Chandra is presently the Director of the National Institute of Hydrology.

Persuing a career of brilliance at the University of Roorkee from where he took his BE(Civil) degree, he had his training at the UP Irrigation Research Institute and joined the University of Roorkee as Lecturer in Civil Engineering. Immediately thereafter, in 1958, he was awarded the Dutch Government Fellowship for advanced studies and training in hydraulic engineering and attended the International Post-Graduate Course in Hydraulic Engineering at Delft in The Netherlands. Reinforced with this advanced training, he conceived the idea of initiating an international post-graduate training programme in hydrology at Roorkee — a reflection of his ingenuity and technical competence. As a result, the Unesco-sponsored International Post Graduate Course in Hydrology was started in 1972, the first of its kind in the developing world.

Obtaining his PhD from the Roorkee University while in its service, he had a distinguished career at the University and rose to the rank of Professor of Hydrology in 1974. Due to his efforts, the hydrology programme at the School of Hydrology (now Department of Hydrology), earned the reputation of being internationally acknowledged as an advanced centre for training and research in hydrology. Under his unending interest to develop the hydrology programme, it has enlarged considerably with the inclusion of a programme in watershed management and the initiation of a proposed programme in snow and glacier hydrology and was provided UNDP assistance to strengthen its laboratories, training and research programmes.

Dr Chandra's involvement in water resources education and research has been both immense and active in national and international fields. He has been a member of the Unesco Committee on Education and Training, Unesco Consultant in water resources education and research to Uganda in 1978 and for establishment of an Institute of Hydrology in Thailand in 1986. He has also been a visiting Professor at the Colorado State University, USA, in 1977.

A keen member of the Indian National Committee on Hydrology, he has been actively connected with the National Institute of Hydrology as member of Working Groups, Technical Advisory Committee and the Society even before joining as the Director. Under his dynamic leadership and guidance, the Institute has progressed to the status of an apex hydrological body in the country and has brought out more than 100 reports in a short span of two years bringing about effective transfer of technology to and interactions with, state field organizations. He has been a member of the Committee on Water Resources to West Flowing Rivers into Arabian Sea and Committee on Water Resources of Southern Tributaries of the Jamuna, appointed by the Planning Commission. He was a leader of the Indian delegation to the Education and Training Committee .and Inter-Governmental Council for IHP, Unesco, Paris; Indian delegation to Steering Committee on Hydrology, New Delhi; and is a leader designate of the Indian delegation to Major Regional Projects in Hydrology for South and Central Asian region at Roorkee. He is presently coordinating the National Hydrology Programme and programme of the Asian Regional Coordinating Committee on Hydrology.

Dr Chandra is an able administrator, active research worker and a reputed educationist. He has conducted and guided research in the field of water pollution, nuclear and remote sensing applications in hydrology, groundwater and water resources and various other aspects of hydrology. He was awarded the Smt Saroma Sanyal Prize for his paper on 'Water Pollution' from The Institution of Engineers (India). He has published over 100 technical and scientific papers in international and national journals and conferences and guided 12 research and 60 master ' degree scholars. He has also chaired and presented keynote address for numerous international and national conferences, symposia and seminars. He has offered consultancy services in hydrology and *water resources to state and central governments.*

Dr Chandra's association with the Institution spans over two decades. He has been a Committee Member of the Roorkee Local Centre for over 20 years contributing significantly to its development and growth. He was Honorary Secretary of the Roorkee Local Centre for two terms during 1968 to 1970 and Chairman from 1982 to 1984. He is an elected member of the National Council of the Institution from the Civil Engineering Division and has served as a member of the Committee for Advancement of Technology and Engineering (CATE), Examinations and Accreditation Committee, Equivalence Committee, and Finance Committee of the Institution. He has. been a member of the Organizing Committee of the 10th FIP and has been .involved with the WFEO Committee on Transfer of Technology. He is a member of the Water Management Forum, and National Design and Research Forum of the Institution. He is also a member of the Indian Society of Earthquake Engineering, Indian Association of Hydrologists, International Water Resources Association, International Association of Hydraulic Research, and the Central Board of Irrigation and Power. He has, as Chairman and Organizing Secretary, organized numerous international and national seminars.

An individual with a wealth of administrative, professional and research, experience, a person with pleasing personality and helping nature, Dr Chandra is dedicated to the cause of engineering which he considers a rewarding experience. With his engineering wisdom, professional competence and dynamic leadership, he is sure to raise the image of the engineering profession and lead it to greater heights in fulfillingthe aspirations of the people and welfare of the nation.

Shri K M Chakravorti

President 1988-89

Presidential Address

It is a rare privilege and indeed a great honour to be the President of the Institution of Engineers (India), the premier learned society of the profession in our motherland. Starting auspiciously with its inaugural President Sir Rajendra Nath Mookerjee, many engineers of eminence had adorned the Chair over the past 67 years, guiding not only the growth of this august body but also elevating its dignity and enhancing credibility at the global scenario as the accredited Non-Government Organization, representing the engineering profession in India. But, it is perhaps destiny that has made me the sixtieth President, and that too by the unanimous choice of the Council of the Institution. What otherwise might be the guiding factors behind the decision, because I know not if I possess any-of the high qualities naturally possessed by my fifty-nine illustrious precedessors. Nevertheless, while thanking the Council and through it, the General Body of membership of this great Institution for the confidence reposed in me, I assure that I will try to do all I can in equating myself to the task, as far as possible, during my tenure as the President.

My association with the Institution of Engineers (India) extends over 40 years during which time I have served the organization in one capacity or the other. I can say from my own knowledge and experience that this Institution, true to its claim, is a progressive body of engineers with aims and objects which are not only contemporarily adaptable but also distinctly futuristic in orientation and having at the same time a Code of Ethics to provide moral base to its Corporate members in the practice of the profession. Over the years I have had the opportunity of watching the after-effects of planning and policy translations making possible the phenomenal growth in membership strength and proliferation of the activities of the Institution, both domestically and internationally. Such opportunities have also provided me with the chance of free thinking about the influence of a professional organization like the Institution of Engineers (India) may have on its members in the advancement of engineering.

Profession and professionalism have acquired new and specialized meanings now-a-days in the modern society which is resting on industrial economy and is dependant on science and technology. In the post-industrial days a transformation has taken place changing the so-called westernized class system into the professional or the occupational system as related to the social structure. Professions, in a way, are division of labour, each area of work having been assigned to different groups of people specially educated or trained or capable of so doing for the overall benefit of the society in its economic as well as a welfare activities. In this context the terminology 'professional' may tend to mean proficiency which is opposite to amateurish and this 'professionalism' may as well be construed as the usage of the proficiency or the expert knowledge in, performing a given task.

I know profession and professionalism is a sensitive subject of sociology and this is not the time and the occasion to enter into any elaboration but I have referred to these two words to articulate the role of a professional body like the Institution of Engineers (India) in relevance to sociology.

In the book 'The Sociology of the Profession' by Philip Elliot it has been stated that 'The professional institutions oversee all the functions of the profession. They lay down standards controlling entry to the group. Through the training necessary to achieve these qualifications, and through association with professional peers, the individual acquires the norms and values of the group. Through these, mechanisms of social control become internalised. Such internalisation is peculiarly necessary because of the opportunities which exist for exploitation in professional practice and because of the loose control which can be exercised by institutions, especially in individual practive situations.'

In course of the past seven decades or so the Institution of Engineers (India) has been thriving for providing the engineering profession and the professionals the required forum as per the above enunciation, but so far its success has been partial. It has not been able to bring many qualified engineers within its fold. Thus, a large section of such personnel in India remains outside any professional obligation or internalization. For control, compulsory registration of engineers through an act of the Parliament may produce a solution.

Social relevance of science and technology occupies a prominent place in the evolution of human civilization particularly in these closing years of the twentieth century. The progress and development of technology are so fast and fantastic and the resultant changes that are being brought about in the life-style of the people are so far reaching that the societal equilibrium itself is tending to get destabilized. The popular writer Alvin Toffler has stated that technology on which modern society is inextricably dependant, is a 'great growling engine of change.'

The take-off time of the phenomenal growth of science and technology may be taken to be the immediate post-World War days, that is since about the middle of the current century. Till the oil embargo in the- seventies the development had been rapid with a booming world economy coupled with the availability of cheap but abundant fossil fuel for energy and without controversy it can be mentioned that the benefits permeated to more and more people, even in many of the developing countries. The Green Revolution, better transport and communication facilities, housing and clothing, health care, education etc may be mentioned as examples. With these developments revolutionary changes in global economy, politics, human relationships etc. also took place affecting the very fabric of the society and the value concepts. Following the oil crunch, the misgivings or the other side of the ambivalent technology are becoming more and more noticeable. Pollution, ecological disturbance, depletion of finite natural resources, population gallop, hunger, threat of the so-called water famine etc. are looming large side by side with the boons of technology.

It is not my desire to discredit the modern technological developments nor to precipitate a panic. My intention here is to highlight the double responsibilities which engineers and technologist must carry. They must dedicate themselves in the march of technological progress taking care of the damaging fall outs at the same time. They must assume leadership in managing technology and the accompanying change rather than remaining consigned in the background.

I have mentioned 'change' several times before. I would like to use that word in one more context before concluding. Here I refer to the changes which are taking place in technical knowledge, in theory and practice alike, with increasingly speedier development and progress in the area. Without goint into the specifics it may be said that newer disciplines in engineering and technology are frequently getting academically accepted which would perhaps be part and parcel of one or more previously established discipline, all because of newer discoveries or developments or arising out of needs. The expanding horizon is constantly opening up newer vistas, newer expectations and therefore newer challenges. The possibilities are boundless and in consequence the shape of things to come even in the near future, say in the year 2000 AD, is hazy, remaining in the realm of futurological predictions.

Under the circumstance it is impossible for an engineer or technologist to rest satisfied on the academic education he -or she received during pupilage. He or she must remain abreast with the newer knowledge, at least in his or her line of practice. Such review or regeneration of knowledge can be achieved by self-study, or through professional group activities, or through periodic participation in organized Continuing Education programmes, or may be through distance education. There are many other ways by which one can update one's knowledge, but I have mentioned a few particularly which come under the purview of direct or peripheral activities already in vogue or in the advanced stage of implementation at the Institution of Engineers (India).

Education or persuit of knowledge is never-ending whereas academic education is a time bound process. An academic degree is not the end of learning but unfortunately has become an accepted trend. To the common man, especially in India, education ought to be a marketable attribute, convertible for personal gains or economic exploits. To him Vidya needs be Arthakari — a money-maker.

Even if the appropriation of this limited meaning of education is acceptable, individual obsolescence at least in engineering and technology due to lack of updating of knowledge cannot be compromised. Continuing Education must be given due prominence.

Ladies and Gentlemen, I have tried to cover a few topics, which to my way of thinking are significant so far as the Institution of Engineers (India) is concerned for rendering services to the profession of engineering in particular and for the benefits of the Nation in general. Certainly there has been no attempt to launch into any learned dissertation at any stage of my address to you but I have attempted to highlight few topics which should be pondered by every well-meaning engineer who is a part of this august body or otherwise. I take it that through the learned audience present here today the message which I have tried to convey will be propagated to the entire engineering community as a whole. I hope with the active participation of more and more engineers the unity and strength of the profession will be consolidated. The threshold of the Institution of Engineers (India) will remain always open for all engineers of India and abroad.

Thank you.

Shri K M Chakravorti—a Brief Profile

Each year the Institution performs an act of electing its President — a position of great responsibility and unique honour with all the challenges associated with it. This year Shri K M Chakravorti, an electrical engineer of high degree of eminence and years of professional experience marked by significant contribution in engineering field, has been unanimously elected as President of the Institution of Engineers (India). He will take office from Dr Satish Chandra, retiring President at the Second Indian Engineering Congress to be held at Hyderabad on January 16,1988.

Shri K M Chakravorti has given a large part of his professional life to the Institution. As a staunch champion of the cause of engineering profession and development of the Institution, the significant services and contributions of Shri Chakravorti are well known to all. Shri Chakravorti has been serving actively the Institution for last three decades at the state and all-india levels. He was past Chairman and Honorary Secretary of the West Bengal State Centre of the Institution of Engineers (India) and a member of the all-india Council for many years. He also served as a member of several Committees of the Council. Though not as a career, Shri Chakravorti has been taking keen interest for the cause of education embracing elementary to higher technical education. He has been associated with the National Council of Education, Bengal, dedicated to the spirit of nationalism since the pre independence era, for almost the most part of his life.

Shri Chakravorti, bubbling with the spirit of nationalism, joined the College of Engineering and Technology, Bengal (National Council of Education) from which the present Jadavpur University has come up and graduated in Electrical Engineering in 1944. He worked as Resident Engineer In Chandpur Electric Supply Co, as Assistant Engineer in Bengal Electric Lamps Works Ltd, Calcutta and also in William Jacks & Co Ltd. Calcutta. He served m/s Siemens India Ltd for almost a quarter of a century and rose to senior management position. He specialized in instrumentation and automation in industries. He had been instrumental in introducing modern testing techniques like electron microscopy, spectrometry, X-ray analysis, gas chromatography for the industries he served. He also underwent training in Siemens, Germany for telecommunication measuring equipments.

On behalf of the State Trading Corporation, Government of India, Shri Chakravorti represented the country to establish a Foundry Forge Project in Syria. He has travelled various parts of the globe in number of assignments.

He served in the Academic, Administrative and Finance Councils of Jadavpur University for various periods. He was also associated with the Regional Engineering College, Rourkela ad representative of the Government of West Bengal. In addition to his deep involvement with the Institution, most of his time is devoted to the development of various organs of the National Council of Education, Bengal.

The election of Shri Chakravorti brings to us a charming personality — conscientious, devoted, selfless and above all a true symbolism of 'plain living and high thinking', His wisdom, dynamic leadership, administrative ability and deep concern for the well being of the Institution will raise the image of the Institution and the engineering profession and lead it to greater heights in fulfilling the aspirations of the people.

Shri P R Bapat
President 1989-90

Presidential Address

I stand here in all humility, honoured by my election as President of the institution of Engineers (India) for the current term. I am extremely grateful to the members of the National Council and through them to the entire engineering fraternity for the great honour bestowed on me.

I am fully aware of the heavy responsibility I have to shoulder and the hard work that goes with this high Office. I pray Almighty to give me enough confidence and Strength to guide the affairs of this national body thereby furthering the contribution of the engineering fraternity and the profession in the continued development and prosperity of our country. I feel certain that with active assistance and continuing co-operation of my colleagues in the Council, the burden of my task will lessen.

I take this opportunity to convey our sincere gratitude to Shri K M Chakravorti, my predecessor, who has served the Institution so ably. I wish to assure him that it will be my endeavour to maintain the standards and harmony set by him in conducting the affairs of the Institution.

Today the whole country is passing through a phase of transition. There is a new awakening in the national development. Definite programmes of actions have been initiated to bring more and more people above the poverty line. Emphasis on industralization, mechanization of agriculture and creating more wealth, laid down 40 years ago, has today reaped rich dividends.

Technological man-power is increasing at a very fast rate. Over 700 institutions are taking in 10000 young aspirants for pursuing a career in engineering. The Institution of Engineers

(India), which itself is a large, open university, has been engaged in training nearly 100000 working people to attain graudate levels through examinations conducted by the Institution every year.

The output of various commodities, eg, basic materials like steel, coal or other manufactured goods, infra-structural inputs like power, transportation, communication or agricultural products have shown phenomenal growth.

The cultivable land, the land under irrigation, has increased substantially. Over the last four decades the activities of construction of dams, housing and other construction activities have increased multifold. There have been large growth and new developments in atomic energy, space research, electronics, telecommunication, etc. Small scale, rural sectors and all other areas of our economy have had substantial growth during this period.

While accepting the democratic process in a country with relatively low literacy, these achievements cannot be under-estimated by any norms. Many studies by the United Nations bodies have corroborated these findings. World Bank authorities, Development Banks and world renowned economists have praised India for these ail round achievements.

On the negative side, however, these achievements have not been enough to fulfil the basic needs of most of our population (both urban and rural) which, however, keeps increasing at an alarming rate! A lot is being said about meeting the basic needs of the rural population. It will not be out of place to say that a lot needs to be done in meeting the basic needs even of the urban population. The urban scenario shows a side-by-side contrast of high-rise buildings and slum dwellings, the latter providing man-power for the former. Sanitation, environmental aspects and noise pollution have become a major nuisance to the whole urban population. Transportion time and cost from place of residence to place of work and the human energy lost in reaching the work place has no comparison any where in the world. However, there is still a continuous inflow of population from rural areas to cities.

Small and medium cities are growing at a fast rate but here again, development of these cities is mostly in an unorganized manner. They have become extension of the rural economy, mixed up with the needs of industrial labour force wanting to catch up with the urban facilities and seek luxuries of entertainment and lifestyle. Basic necessities of clean and pure water, education, health services, availability of goods and services, food commodities, milk and other facilities at reasonable prices are not available and the overall living conditions are inadequate and unsatisfactory.

Government's objectives of decentralization of industry and development of more and more cities and towns to avoid congestion in a few major cities, and thus spread the population over wider areas, have not been met due to this phenomenon. Quality of life in all these places is far from satisfactory. Major cities are reeling under the burden of continuous influx of population. Human endurance, socio-economic culture and our heritage have helped us to continue living in such pathetic conditions sheerly because of our nature of tolerance, way of life, of taking many things for granted and accepting conditions as they arise. This character is reflected in every walk of our life.

Taking stock of the situation, one wonders how we have let things slide so far for such a long time. When one looks at possible remedial measures, one realizes that it is not the shortage of natural resources, it is not the shortage of talent and ability to work, it is not shortage of funds, but it is lack of quality and professional management of the whole system. It is lack of understanding our problems in their true perspective. It is the lack of giving right priorities to right things. Above all, it is the habit of blaming others except oneself like 'Government should have done,' 'public sector is inefficient,' 'organized sector is making money,' 'rich are getting richer,' 'urban population is living at the cost of rural population' and the famous controversy between technocrats and administrators and so on that has continued this sorry state of affairs in spite of growth in all sectors of our economy.

A panoramic review of this scenario through which various sectors of the economy are passing through is not taken to blame someone but to bring home the point that all the achievements of scientists and technologists, engineering, medical and other professionals have fallen short of the expectations with the result that we have to live in the economy of shortages, constraints, redtapism, procedures and forms. The time has now come to review these and see how the system can be completely reoriented to facilitate development oriented growth.

Over the past 2-3 years, we have seen a totally different climate on the industrial front. Removal of protection that was being given to the economy in general and industry in particular has shown us the way. We have seen that enthusiasm and systematic action can result in effective production of national wealth and not just mere increase in gross national product. It not only helps us to take stock of our achievements and our current problems but also helps us to restructure ourselves to meet new challenges of freedom after 40 years on crutches and support through controls. It has opened our eyes to assess our hidden strengths and capability to meet the challenges, to deliver goods and services, to manufacture products of quality comparable with international standards. It has helped us to look at the measures for improving productivity, cost effectiveness, quality consciousness and change the theme of the whole industrial activity to 'the consumer is the boss' approach and not to live in the old philosophy of sellers market and, as one of my industrialist friends has said, 'Shake off the *Chalta Hai* approach.'

The industry is now looking to modernization, technology upgradation, automation, mechanization, use of high technology; bringing into the country the latest technology without the false pride of *Swadeshi* and making these resources available to the common man with free competition both within the country and foreign countries, within the private and public sectors, within the small and large sectors, within the organized and unorganized sectors, within indigenous and foreign techchnology. We see various long term prespective development plans being drawn up by various sectors of our economy like steel, coal, energy, power, transportation, automobile engineering, machine tools, electronics, telecommunication, space, atomic energy, etc. The defence sector has been thrown open to the industry. The industry is now looking outward to increase exports, to take help in improving technological inputs and to make available technology for producing goods and services for meeting the needs of the large population. One has to remember that we shall be a billion people by the turn of the century which is just a decade away. This opening of gates and freedom of action has shown us the way as can be seen from the confidence that the leaders of the industry are exhibiting through their development plans and through the large resources that are being put into various sectors of the economy.

The time has now come for us to extend this liberalization approach further to the rural sector of the economy. We have to look at how the needs of the large rural population be converted into demands; how we can create, in our massive population, the purchasing power to buy the goods and services; how we can generate gainful employment; how we can give them basic facilities and other infrastructure. Only then we can say that the benefits of science and technology have reached large masses and there is improvement is quality of their life. Only then we can see that the rural population does not migrate into urban areas and creat problems to both zones.

One can see that we are at the cross roads. Outside agencies can only help us in bridging resource gaps, in technology inputs and, wherever necessary, give financial assistance but the large technical man-power in the country has to rise to the occasion and to ensure that the wind of change in the national scenario helps them to reorganize themselves and every sphere of activity to meet the challenges.

The Institution of Engineers (India), which is the primary body of engineering fraternity with over 300000 members, spread over 90 major cities and industrial towns in the country with physical facilities in all State Capitals and other centres, has vast resources and can play a vital role in the transformation of the economy. A review of its beginning, recent past, present strength of its resources and a spectrum of its activities will be useful to emphasize this role of the institution.

THE INSTITUTION IN RETROSPECT

The need to build a society for engineers, to have a common platform to hear their associates talk of new advancements and new products, was felt in 1916 which received public prominence in a report of the Industrial Commission 1916-18 of which Sir Thomas Holland, the then Commerce Member of the Government of India, was the Chairman.

Based on the efforts of engineers in Bombay, Calcutta and other places in 1918-20, the Institution was founded under the Indian Companies' Act of 1913 on September 13, 1920.

At that time, the impossibility of maintaining a separate organization for each branch of engineering was obvious when the members of the profession were dispersed over a large area. The alternative—which time has proved eminently satisfactory—was to found an all-embracing society, incorporating all engineers, irrespective of their specialist functions. Sir Thomas Ward, who was then the Chairman of the Organizing Committee, became the first President of the Institution. He was succeeded by Sir Rajendra Nath Mookherjee in November 1920.

Bengal, Bombay and the United Provinces' associations came into being in 1921. These were followed by those of South India in 1922 and North West India in 1927.

In 1972, the Council announced the first list of expected educational qualifications for exemption from Sections A and B of the Associate Membership examination of the Institution. The first examination was held in August 1928. The office of the institution was moved to the new building at 8 Gokhale Road, Calcutta, on January 1, 1932.

In September 1935, the Institution received its Royal Charter—the first Royal Charter to be given to a body which has its origin and functions in India. As per the Royal Charter, the objects and purpose for which the Institution of Engineers (India) was constituted are to promote the general advancement of engineering and engineering science and their application in India and to facilitate the exchange of information and ideas on those subjects amongst the members of and persons attached to the Institution and otherwise.

As early as 1929, the Institution realized the need for and importance of specialized branches and disciplines in engineering under the overall umbrella of a single institution. The then President, Mr E J B Greenwood, in his Presidential Address, said:

'I view with mixed feelings the attempted growth in India in recent years of kindered institutions of an engineering nature; the fold of our Institution is wide and our membership includes distinguished representatives of all branches of engineering and its allied sciences. It is conceivable and will inevitably occur that our Institution will form special sections to deal with subjects such as railways, irrigation, water supply, electricity, reinforced concrete. All such sections, however, will remain integral parts of the institution and we may visualize a state in the future when our Institution consists entirely of such sections.'

Time was to prove the remarkable truth of this statement.

On the outbreak of War in 1939, the Institution conveyed to the Government its readiness to co-operate in every scheme calling for engineers and engineering materials and placed at their disposal the accumulated experience and facilities of the Institution. In 1942, the Institution was invited by the Government of India to advise them on the preservation of the Taj Mahal. The Institution has been invited to advise the Government on many such special assignments of national importance.

Four major sections, namely, civil, mechanical, electrical and general engineering were formed in 1944.

During the Silver Jubilee Year, the then President, Nawab Zain Yar Jung Bahadur, said in his Presidential Address:

'We have to rebuild and reshape the whole of our national life, and we could take no better resolution on this occasion of the Silver Jubilee of the Institution than to pledge ourselves to attack with all the tools and implements, the machinery and equipment, the mind and the imagination of the engineer, the triple alliance of poverty, ignorance and disease which holds our country in its relentless grip.'

I do not have to emphasize how valid this statement is even today after four decades.

After Independence, attempts were made to obtain a charter for the Institution from the Government of India. In 1958, the Attorney General gave his opinion that the Institution constituted as a body corporate by the Royal Charter. This Charter continued to be in the eyes of the law a body corporate not withstanding the changes in the Indian constitutional structure after Independence, since at the time of grant of the Royal Charter in 1935, the Charter was a law in force in the territory of India.

The Institution has been acting as the Indian National Committee for the World Petroleum Congress since 1950 and represented India at the Congresses held in 1951, 1955, 1959 and 1963. After the Sixth Congress in 1963, this responsibility was transferred to the Oil and Natural Gas Commission (ONGC).

Since then, the Institution has come a long way. There has been a galaxy of eminent personalities heading the affairs of the Institution whose members number over 300 000. Membership as on September 30, 1988, is as follows:

Fellow	9 599	
Members	37 254	
Associate Members	26 437	73. 290
Senior Technicians Technicians Student Members	214 550	
Affiliate Members	57	
Donor Members	117	
Institutional Members	25	
Students (attached to Engineering Colleges and Polytechnics)	45063	333 102

The Institution is an open university conducting examinations since 1928 for practising technicians and persons aspiring to enhance their theoretical knowledge and become graduate engineers. Currently, the Institution conducts examinations at 46 centres. During 1987-88, over 100000 students took advantage of these examinations not only within the country but also in a few centres in the neighbouring countries. The number of students who sought admission to these examinations in 1987-88 are given below:

Studentship	4713
Section A (Non-diploma)	28 305
Section A (Diploma)	53 277
Section B	23 854
Section C	27
Total	110 176

The Institution's 90 centres include State Centres located at all State capitals and centres located in major Cities and industrial towns throughout the country. These centres conduct extensive technical activities like lectures, seminars, round table conferences, intensive tutorials and workshops, national and international conferences, continuing education courses. They liaise with the engineering fraternity, educational institutions and other professional bodies, associations, administrators, economists and political scientists during the various programmes and technical activities and take active part in topics of national and state interest. The centres are invited to give advice on many issues of national importance. During a year over 2000 such technical activities are conducted at various centres.

The centres thus form major link of the Institution in liaisoning with the engineering fraternity and others.

The 15 Divisions each have two annual paper meetings and an annual convention wherein the advancement in technology, research studies, practical experience and case studies are discussed by educationists, R&D scientists and practising engineers.

All Divisions gather together at an annual Indian Engineering Congress held at different locations. The Congress programme includes memorial lectures by eminent personalities, honouring distinguished personalities in the profession, national seminar on a current topic, technicians and students seminar apart from usual Council and other meetings for the administration. The Council of the Institution, which is the supreme body representing members from Divisions, centres and states, and distinguished personalities, meet four times a year to guide the affairs of the Institution. Many committees such as the Finance Committee, the Examination Committee, Accreditation Committee and Committee for Advancement of Technology and Engineering meet more often.

The 15 Divisions are guided by the Divisional Board, members of which are Council members attached to the respective Division and headed by the Chairman. The Committee for Advancement of Technology and Engineering deliberates on long-term technology and national issues and guides the deliberations.

Every year, the Institution celebrates September 15 as Engineers' Day to commemorate the memory of the late Sir Mokshagundam Visvesvaraya when seminars on common topics are held at all the centres.

The Institution publishes refereed journals of each Division, Bulletin and Hindi Journal, Technicians Journal, Students Journal and proceedings, conclusions and recommendations of various seminars. The recommendations of seminars are taken up with appropriate authorities for their implementation.

The Institution has 40 Technician Chapters, 198 Student Chapters in Engineering Colleges and 139 Student Chapters in Polytechnics. It has foreign chapters in London, UK; Manila, Phillipines; UAE, Dubai, and Abu Dhabi.

Currently, the Institution's technical activities are channelled through 15 Engineering Divisions, subdivided into major groups. The membership of each Division as on September 30, 1988, and their groups are shown below:

Division	Membership as on 30.9.1988	Groups
1. Architectural Engineering	262	-
2. Aerospace Engineering	191	-
3. Agricultural Engineering	394	-
4. Chemical Engineering	1866	
5. Civil Engineering	28 541	Construction Planning & Management/

		Earthquake Engineering, Geotechnical Engineering/Hydroloy & Hydraulic Engineering/Ocean Engineering/ Railway Engineering/Traffic & Highway Engineering & General Engineering
6. Computer Engineering	920	
7. Electrical Engineering	12 856	
8. Electronics and Telecommunication Engineering	2651	Circuits and Systems/Communication Engineering/Computer Control and Automation/Electromagnetics/ Electronic Devices and Solid State/ Radar and Microwave Engineering/ Testiong, Evaluation, Quality Control and Measurement
9. Environmental Engineering	1012	-
10. Mechanical Engineering	19626	Control and Stability of Mechanical Systems/Fluid Mechanics and Machinery/Machine Dynamics Vibration and Noise Solid Mechanics and Materials Technology/Thermal Engineering System/Design of Mechanical Systems/ Plant Engineering/Refrigeration and Air Conditioning/ Terotechnology and Maintenance Engineering/Tribology, Lubrication and Bearings
11.Marine Engineering	1155	-
12. Metallurgy and Material Science	981	-
13. Mining Engineering	820	-
14. Production Engineering	1511	Automation Control and Robotics/ Casting and Welding/Computer Applications in Manufacturing/Human Engineering and Ergonomics/industrial Engineering/Machine Tools and Tool Design/ Machining Processes/Metal Forming Processes/ Operations Research and Production Management
15.Textile Engineering	504	
Total	73 290	

The Institution has three important functional committees, namely, Finance Committee, Examinations Committee and the Committee for Advancement of Technology & Engineering (CATE).

To identify the need of specialized areas of continuing education in new emerging areas and train technical man-power in these specialized fields, the Institution has Started the Engineering Staff College of India(ESCI) with its headquarters at Hyderabad on land donated by the Andhra Pradesh Government and activities spread throughout the country.

Specialized activities are conducted through four forums, namely, National Design & Research Forum (NDRF), Water Management Forum (WMF), Rural Development Forum (RDF) and Extra High Voltage Forum (EHVF). The contributions of these forums. in activities vitally important in meeting national challenges are phenomenol. The work of these forums can be gainfully utilized in our nation building process. We will need to spread them to all Centres of the Institution.

RDF has identified that the strength and growth of India depends on the ability of its rural sector to absorb engineering and technology by modulating new innovations towards enrichment of the techno-economic base of rural masses. It has been proven that rural people are intelligent and wise and willing to accept technogical innovations provided they are given practical illustrations and demonstrations. The Rural Development Forum organizes regular caravan walks to remote villages in order to interact with new technological innovations and learn from each other the experience of new adaptable proposals in rural habitat; rural environment; rural sanitation; food preservation; food processing; use of alternative technology; rurally adaptable household devices, rural industries; etc.

The RDF has completed several new R&D projects like fabrication of a low cost solar grain dryer; fabrication of low cost sanitary latrine using fibre glass pans; fabrication of a low cost field-pump for irrigation; fabrication of low cost solar cooker; a novel design of mud pot oven; high speed handloom and fabrication of a rural wind mill. It has already established a design model of rural auditorium as a demonstration centre for rural people. A few more models are being designed. A suburban model auditorium was constructed which can also fit into any rural scenario. During the current year, two novel programmes have been developed to train rural technicians, One in Hindi medium and another in Bengali medium, to develop skills in (a) mechanical trades, and (b) electronics. The RDF activities can be and should be spread to all centres of the Institution who can contribute in taking technology to the masses.

The Institution has entered into bilateral agreements of technical understanding with 12 societies abroad and agreements with three are in the offing:

1. The Hungarian Federation of Technical & Scientific Societies (MTESZ)
2. The All-Union Council of Scientific & Engineering Societies (VSNTO), USSR
3. The American Society of Mechanical Engineers (ASME)
4. The American Society of Civil Engineers (ASCE)
5. The German Engineers Association (VDI), West Germany
6. Central Union of Science & Technology of Bulgaria (CCNTS)
7. Union of Engineers & Technologists of Yugoslavia
8. The Chinese Association of Science & Technology (CAST)
9. The Canadian society of Civil Engineering (CSCE)
10. Technical Society of Science & Technology, Czechoslovakia
11. The Polish Federation of Engineering Associations (NOT)
12. Nepal Engineers Association (NEA)
13. Argentina Union of Engineering Associations (UADI) (in the offing)
14. Clube de Engenharia of Brazil (CE) (in the offing)
15. Chaimber of Technology (GDR) (in the offing)

The Institution has been holding international conferences and seminars in India. During the past few years, the Institution hosted following major international events:

1. Commonwealth Engineering Conference, New Delhi, 1969
2. International Conference on Production Engineering, New Delhi, 1977
3. IFAC International Symposium on 'Computer Applications in Large Scale Power Systems', New Delhi, 1979
4. 12th Congress of World Energy Conference, New Delhi, 1983
5. 12th Congress of World Mining Congress, New
6. Second World Congress on 'Engineering and Environment', New Delhi, 1985
7. 10th International Conference on Prestressed Concrete, New Delhi, 1986

The Institution represents India as National Member at the following:

1. World Energy Conference (WEC)
2. World Federation of Engineering Organisations (WFEO)
3. Commonwealth Engineers Council (CEC)
4. International Federation of Automatic Control(IFAC)
5. Federation Internationale de la Precontrainte (FIP)
6. Institution of Production Engineering Research (CIRP)
7. World Mining Congress (WMC)
8. International Council of Aeronautical Sciences (ICAS)
9. Federation of Engineering Institutions of South & Central Asia(FEISCA)

The Institution thus has a wide diversified network of associated institutions around the world which could be constructively utilized by the engineering fraternity to have a useful interface with world authorities on technological issues, learn from each other's experiences, evaluate impact of the research and development work to solve problems of national importance. The engineers and the institution can thus become an instrument of change and help meet the national challenges.

An analysis of the guidelines laid down by my predecessors would also be helpful in giving directions to our future actions and planning our strategies.

THE IMMEDIATE PAST

The development of the Institution and its role are governed by the directions given by the Council of the Institution headed by its President. I would now review the approaches emphasized by some of my predecessors which can help us set pace to follow during the year and set trends for the years to come.

PRESIDENTIAL ADDRESSES

Dr Jai Krishna (1974)

Need to develop inter-disciplinary areas of engineering interacing with applied sciences, eg, chemistry, physics, geology and metallurgy.

Challenges and opportunities for technical Institutions—depletion of natural resources, forests, nonreplenishable earth resources, metal and energy resources, etc.

All the while our members grow, our aspirations rise and our options recede. We have indomitable human spirit and power of human intelligence and its urge to utilize Knowledge for creative purposes.

Engineering is central and vital to the fulfilment of community tasks and achievements of national goals. I need not emphasize that we are today at a critical juncture in the life of our nation and it is our duty to assure the nation of our unstinted patriotism and desire to serve it to the best of our ability.

Dr V M Dokras (1975)

Speaking on 'Inventive skills vis-a-vis intermediate technology vital to our future', he said, the principal objectives on which we need to focus attention would be:

1. To relate the national S & T polices more explicitly, to clearly define economic, social, defence and other objectives, to provide clear orientation of efforts.

2. To define possible contributions S & T could make to a wider range of national objectives.

3. To strengthen communication and co-operation among industry.'

Dr A Bhattacharya (1976)

Today we are faced with crises of many sorts. Above all, there is a 'crisis of confidence.' in this vast country of ours we have a mighty potential of responsive manpower, almost unending national resources, a proud heritage and a bold and imaginative leadership which is vigourously working for the nation's economic recovery and growth.

Engineers and technologists can harness out of this potential whatever is needed for societal causes, particularly for the cross-section of our people who have suffered for ages and desperately need a new way of life. Let them have confidence in us and let us have confidence in future.

Dr A Bhattacharya (1977)

On 'Engineered Effort and Energized People Essential for the Nation's Emancipation,' he said, The Council fully recognizes the enlightened guidance and new directions that are being given by our Government to reach the envisaged goals of eradicating poverty, solving unemployment, enhancing productivity and thereby ensuring all round national development through self-reliance.

In keeping with our rich heritage, let us pledge our whole-hearted and unstinted support to the dynamic leadership of our Prime Minister in carrying out the task of accomplishing the new programme for the welfare of the people. With the conviction and avowed faith that engineering has a great lot to contribute to our continuing battle to rise to our national status and prestige. Let us pledge with all dedication that we will commit our total strength at all times and on all occasions to the Government in its relentless, diverse endeavours to serve the people of this great country.

Lt-Gen J S Bawa (1978)

On 'Role, Image and Responsibilities of Engineers', he said, I have placed before you a number of new ideas and suggestions which may be followed by engineers in brightening their image and increasing their basic qualities and ability to serve the nation.

Lt-Gen J S Bawa (1979)

On 'Appropriate Technology for Development of India,' he said, Rapid socio-economic development of India calls for identification of the people's needs and implementation of S & T plan which should clearly spot out the goals to be achieved.

An integral network of institutional framework at national, regional and intermediate levels in required to accelerate indigenous development and transfer of technology. Not only we have to train and prepare ourselves from today, not only to select the appropriate technologies to meet the basic necessities and aspirations of the common man, but also to forge the instrument through which we have to implement this goal.

Shri S G Ramchandra (1980)

On 'The Nation's Development in Perspective— Engineers' Task Now and Later,' he said, For the next few years, the Institution's main objective should be to reflect the concern of the engineering profession on matters of economic development and organize the professional men at the State Centre, Local Centre and Sub-Centre levels and as the most authoritative repositories of knowledge related to the diverse activities and to the development requirement of each state and region. In the recent past, planning of technical activities of the Institution through Divisional Boards and CATE have shown definite results. The Institution should now give a sense of direction to the technical activities at State level. Knowledge knows no barriers. Let us, therefore, shed the feeling of helplessness and march ahead. May the profession, gain in stature as an innovative, problem solving, productive fraternity.

Shri S G Ramachandra (1981)

On 'Engineers—an Instrument of Change,' he said, Thrust of the large membership will be in areas where transfer of technology is urgent to solve the enormous problems arising out of population growth, movement and education, improvement in literacy has brought an increased awareness in our people and the resulting political and socio-economic pressures Can be successfully handled by organizing ourselves to rapidly transfer appropriate technologies for the benefit of the masses in the shortest possible time.

Prof Shankar Lal (1982)

The need of the hour is unity amongst ourselves and hard work by each one of us. The Institution of Engineers provides the profession with a forum and a voice. We must use the Institution in assuming leadership roles in various spheres of the country's development and defence. We must learn to give ourselves. We must accept that the individual owes more to the profession than the profession owes to the individual.

Shri M D Patel (1983)

Speaking on 'Transportation,' he said, The Institution has been continuously readjusting its activities in keeping with current trends to ensure appropriate recognition on matters of national concern—ecolagical, conservation and aesthetic values—in the development of public works and services. The human dimension has been receiving the utmost attention in all its new and re-vitalized professional committees and programmes. The leadership of the Institution has fully recognized and extensively committed itself to the need for regular discussion on energy, transportation, materials, water resources, land use, rural development, public health, ecology, pollution abatement, etc—all vital aspects that influence the quality of life. In these contexts, it is in a pre-eminent position to communicate more effectively with the members and though their increased collective participation, pool and disseminate knowledge which will assist national development.

Shri S K Mukherjee (1984)

Science policy and technology policy statements relate to plan of action needed in the industrial, agriculture and service sectors with main objective of bringing benefits of development to the weakest members of society—predominently rural poor. The problems of the future will not only be technical in their spread but will include the socio-economic dimensions. We are pledged not to engage in wishful thinking but surmount difficulties. We shall surely overcome all obstacles, however mountainous. We are ready.

Shri C R Alimchandani (1985)

It is my duty to help the Institution to realize its principal objective of providing the highest level of engineering service to the nation. We have a role to play in building up the qualitative and quantitative strength of engineering man-power falling under each of its 15 Divisions.

The engineer's role is inadequately understood perhaps because he works somewhat removed from the gaze of the general public. I seek not the esteem of society as reward for the engineer's work. All I desire is that our country visualizes correctly the key role her engineers must play in solving her great economic problems.

Prof B R Narayana lyengar (1986)

'Towards National Advancement,' he said, 'I have enough faith in our youth and I want them to ponder over an old saying: 'It is not what you have that matters but it is what you do with what you have that really matters,' and act accordingly.

Dr Satish Chandra (1987)

An engineer is a creative person and an effective agent who can bring about the change in the living standards of the people by delivering fruits of research and technological development to society. We, in India, would have to work with redoubled vigour to reduce the technological gap with other countries. With this conviction and avowed faith that engineering has a great lot to contribute to our continuing battle to raise our national Status and prestige, let us pledge with all dedication that we will serve with our total strength at all time and on all occasions help the Government in its relentless diverse endeavours to serve the people of this great country.

Shri K M Chakravorti (1988)

Profession and professionalism have acquired new and specialized meaning in modern society which is resting on industry and is dependent on S&T. In the past seven decades, the Institution has not still been able to bring many qualified engineers within its fold. Compulsory registration of engineers through an Act of Parliament may give a solution. Engineers and technologists must carry double responsibility—dedication to assume responsibility in managing technology and managing the accompanying change.

Newer discoveries or developments are surfacing out of needs. The horizon is constantly opening up newer vistas, newer expectations and, therefore, newer challanges. The possibilities are boundless and, therefore, the shape of things to come even in the near future is hazy, remaining in the realm of futurological predictions.

THE INDIAN ECONOMIC SCENARIO

in order to make our actions more effective, we shall review the Indian economic scenario as brought out by many renowned scientists, economists, politicians and leaders of industry to bring home how the economy is being readied for 21st Century by preparing to take bold steps and evolve a revolutionary approach to the Eighth Plan.

Manu Shroff, Editor, Economic Times, while reviewing the Indian economy in 1989-90 says: 'By all counts, the economy is poised for fulsome recovery from the dumps in which it was plunged. The country is green once again. Reservoirs overfull. No wait for truck loads of fodder from distant villages. No need to wait on officious Babu. Here is an opportunity to convert bounty into a meaningful regeneration of economy.

The Indian economy is all set to achieve a higher growth path during 1989-90 to the extent of 10%-12%. The Eighth Plan Policy package will have a better chance to succeed if it gives the economy a breather in 1989-90 which is the next Plan's base year.'

In another review of 'Indian Economy in Restrospect,' M Jayalakshmi and Deepak Mohanty write: 'More than three-and-a-half decades of Plan exercises in India have produced tangible economic gains with significant institutional changes. A look at the Indian economy reveals that on an average it grew at 3.69% per annum. Between 1950-51 and 1969-70, GDP grew at 3.62% per annum whereas between 1970-71 and 1985-86, it grew at 4.05% per annum. The eighties have witnessed a further step up in the rate of growth at around 5.01%, thus raising hopes of a new growth path. The normal trend in population growth has been around 2.91%. The trend for the first period was 2.08% which increased to 2.25% in the second period which justifies the anxiety of the Planning Commission regarding the population problem. All development efforts will come to nought if there is a surging mass of hungry to feed. The impact of population growth on domestic product is evident in the low growth of per capita income—1.40% for the 36-year period.

The National Account Statistics classify the output Originating from the economy into: Primary Sector (which includes agriculture, forestry, logging, fishing, mining and quarrying); Secondary Sector (which includes construction and electricity, gas and water supply); and Tertiary Sector (which includes transport, storage and communication, trade, hotels, restaurants, financing, insurance, real estate and business services and community, social and personal services).

The following table gives selected macro-aggregate growth rates in percentages:

	1950-51 to 1985-86	1950-51 to 1969-70 (Period I)	1970-71 to 1985-86 (Period II)	1980-81 to 1985-86
1. Gross Domestic Product (GOP)	3.69	3.62	40	5.01
2. Net Domestic Product (GNP)	3.6	3.5	3.98	4.86
3. Population	2.19	2.08	2.25	2.12
4. Per Capita Net National Product	1.35	1.32	1.56	2.42
5. Gross Domestic Product — Sector-wise:				
5.1 Primary Sector	2.28	2.01	2.31	3.07
5.2 Secondary Sector	5.14	6.53	4.32	6.72
5.3 Tertiary Sector	5.0	4.92	5.99	5.86
5.3.1 Public Administration and Defence	7.56	6.82	9.22	6.74

In concluding the review of the Indian economy, the authors summarise that time and again the resilience of the economy resolutely surfaces in the face of most adverse circumstances. The inherent strength of the agricultural economy, rapid and sustained development of the industrial sector, giant strides made in the tempo of infrastructural development are the strong points emerging from the economy's development lessons. The continued sensitivity of the agricultural economy, specially foodgrains production to variation in monsoon is a matter of serious concern. More so, as almost 70% of the total agricultural land is still rain-fed. Another area of concern is the slow growth in the productivity of non-food grains. These inconsistencies seem to give lie to the tall claims of the success of the green revolution.

Turning to the industrial sector, the authors further observe that excess capacity and high cost have been the bane of industrial development. Recent achievements in industrial production could be mainly contributed to the healthy growth of infrastructure industry and certain fast growing sectors like electronics. Attempts should be made to consolidate the gains, infuse an element of competition so that it is able to attain high standards of international competitiveness.

Another cause of worry is the resource crunch. One finds that the high saving phase of the late seventies has not been sustained in the eighties. The mid-term appraisal of the Seventh Plan observes: 'A restraint on private and public consumption expenditure is necessary to raise the level of domestic savings for sustaining the new growth path.'

Dr Bimal Jalan, Chief Economic Adviser in the Finance Ministry for the last seventh years and now joining the World Bank as Executive Director on the Board of IMF, while analyzing the country's economic successes and failures in the eighties, says: 'The economy/policy making is an inter-active process. Tackling of the second oil shock in 1979-80 and the management of last year's drought were the two main achievements of the last 10 year on the economic front.'

According to Dr Jalan, 1979-80 was the worst year in the recent history in which the infrastructure was in shambles. There was a 15% drop in agricultural production. Inflation rate was 22%. Economy could have cracked up but we were able to get out of the problem which was an important macro-economic achievement. Management of drought last year was also an achievement. Government released 20 Mt of foodgrains in 12 months. It controlled budget deficit. Dr Jalan said that if we achieve 8%-10% growth this year, we would be back on the track.

With an annual growth of 5% in the last 10 years, India has done well. However, there are long term worries in terms of agricultural growth to which the Planning Commission is now paying attention. There are worries in regard to balance of payments and exports. Government expenditure is another area requiring attention. The problem of sick industries is also a worrying factor. We have to find ways of tackling these problems without causing distress.

We are seeing fast growth of exports in the last one-and-a-half years but the problems are of fundamental nature. Industry grew amidst a high rate of protection. Changing this process is a very long exercise. Dr Jalan says that liberalization is much more a process of debureaucratization. Given the changing structure of our economy and its increasing sophistication, it is not possible to run the system with detailed centralized administrative controls. Most industries now face greater competition than before, more units are getting more economic in size in almost all sectors. India is a case by itself because of its history, size and heterogenity. We have learnt from experience which was not available to the earlier policy makers.

The Planning Commission has set 6% goal for the Eighth Plan. In a country as diverse as India, and depending on rainfall, a growth rate of average of 6% for the entire country is not unreasonable. Some problems have long history like the public sector and sick industry, there can be no quick fixes. You cannot wake up one fine morning and find everything is all right with the public sector. There are some historical reasons when certain units continue to show losses. Correcting this is difficult and it takes time.

We have to give higher priority to improving living conditions of our people. Improvement in public services, higher and more efficient public investment are, therefore, of great importance. We have to come down to brass tacks and devise policies which will actually deliver results. We have to recognize the limits of administration and policing of economic activities.

Prof Maicolm Adiseshiah, the renowned economist, observes that 1988-89 is the year of 'consolidation and repair.' It should be a year of rehabilitation of the agricultural sector. Prospects for the industry, according to Prof Adiseshiah, are far dynamic as industrial growth rate is expected to deciline from 7.6% in 1987-88. He says that the growing trade deficit, now touching Rs 10000 crores, is a matter of grave concern. This coupled with sharp fall in foreign exchange reserves will force the Government to cut back on imports. He is skeptical of achieving Governments projection of 6% growth rate.

This analysis of our national economic scenario by some well-known authorities on the subject can guide us to understand the Eighth Plan targets and tasks involved in achieving those targets.

CETTING READY FOR 21ST CENTURY—THE EIGHTH PLAN

The Eighth Plan is being formulated in this background. There have been series of discussions on the expected growth rate. At the instance of the Prime Minister, different models for different growth rates, ranging from 5.5% to 7% and their implications, were worked out before finalizing an average growth rate of 6% for preparing the Approach Paper for the Eighth Plan. The higher rates of 6.5% and 7% were ruled out as they were not considered feasible. The primary objectives set for the Approach Paper are: Firstly, to meet the basic needs of the people in terms of food, clothing, shelter, health, education and energy; and Secondly, to ensure that the composition of the growth is such that it emphasizes growth of employment and growth strategy to enhance the country's self-reliance.

While deciding the growth rate target, the Prime Minister said that social justice and efficient use of resources should form guidlines to be taken into account. Higher growth rate was required to alleviate poverty, meet the aspirations of the people and maintain the country's position in the international economic sphere. The Commission felt that growth rate of 6% should be feasible if resources are utilized more efficiently.

According to the Planning Commission's work outs, this growth rate would require lowering the incremental Capital output ratio from 4.6% at the end of Seventh Plan to 4.35% in the Eighth Plan. It will require raising Marginal rate of private saving to 37% and rate of overall saving to 39.4%. It will require raising the tax rate from 17.4% to 20% of the GDP and containing Government expenditure to 13.3% in the terminal year of the Plan.

Total investment requirements for 6% GDP growth have been estimated by the Planning Commission at Rs 649926 crores against total growth of revenue on the basis of 1989-90 prices of Rs 488065 crores. The growth of total revenue including effects of additional resource mobilization will mean availability of Rs 531600 crores leaving a gap of Rs 118326 crores.

Against this target fixed by the Planning Commission, the industry associations like FICCI have done their own homework and have come to the conclusion that with proper management of inputs and resources and proper incentives, 7% growth in the Eighth Plan is possible.

The FCCI plan spells out the desired level of resource generation, investment and sectoral growth rates.

REVIEW OF EIGHTH PLAN ACHIEVEMENTS

The Eighth Plan was formulated against the perspective plan of 1985-2000 with the objective of elemination of poverty and creating conditions of full employment, Satisfaction of the basic needs of the people in terms of food, clothing, shelter, attaining of universal elementary education and access to health facilities for all. According to the Plan, it should be the aim to create by 2000 AD the conditions for self-sustaining growth, to finance growth internally development of technology.

During the first three years of the Eighth Plan, the pace of public investment has been maintained at the required level. There has been a marked improvement in infrastructure and industrial growth has been sustained at a very high level for three successive years. Yet, the Indian economy has not picked up the targetted growth rate mainly because of very low to negative growth of agriculture. The targetted growth rate of Eighth Plan will be achieved, according to mid-term appraisal, by correcting the shortfalls in creation of agricultural potential, maintaining the positive development in industry and infrastructure, mobilizing and coping with emerging pressures on the balance of payments.

The various study tears of the Planning Commission engaged in the preparation of the Approach Paper are fixing up targets which look gigantic as can be seen from the following data:

Energy and power form the most vital input to the whole economy. On the energy front, the additional target of 22245 MW in the Eighth Plan is expected to be exceeded. Plans are in hand to add 38000 MW (12129 MW hydro, 26341 MW thermal and 1410 MW nuclear) more power in the Eighth Plan.

Actions have been initiated to ensure that the projects indentified for giving benefits in the Eighth Plan are executed expeditiously. It is proposed to take up some short gestation gas-based power stations from which 5 000 MW or more capacity is likely will be set up in the Eighth Plan. The estimated fund requirement for the power sector in the Eighth Plan is Rs 80000 crores.

Even then, there will be shortages ranging from 4% to 15% in north, west and southern regions and 7% to 10% in the east and north-east sectors. Attention is being given to reduce T&D losses, strengthening the power system network, renovation and modernization of existing plants to maximize the output from these units.

Efforts are on to raise crude oil output by 15 Mt with an investment of Rs 11000 crores during the Eighth Plan—over 65% of additional oil production will come from fields other than Bombay High. Production during the last year of the Seventh Plan (1989-90) is expected to be about 40.1 Mt of oil and oil equivalent gas (31.4 Mt of oil and 8.69 Mt OEG). ONGC expects to produce about 46 Mt of oil by 1994-95 in the terminal year of the Eighth Plan.

There are, therefore, active steps being taken to tap hitherto untapped sources of energy particularly in rural areas like wood, coal, gas, animal dung, etc.

The systematic attempt to exploit bio-power can help in large scale employment generation in rural areas. Three major factors in bio-mass based power generation programmes consist of agricultural residue utilization, agro-industrial residue utilization and wasteland utilization for energy plantations (total employment generation per hectare of wasteland put to energy plantation works out to between 400 and 800 man-days per cropping cycle). Cumulative employment potential with a programme of 2.5 Mha wasteland (out of 62 Mha waste land available) works out to 1500 million man-days for unskilled labour. To this must be added the likely employment generation potential for semi-skilled, skilled, highly skilled workers and trained professionals.

This can result in foreign exchange savings due to saving of imported petroleum products like HSD. Likely impact from agricultural residues and agro-industrial residues by the year 2000 would be about 10 Mt HSD annual and foreign exchange saving of Rs 2400 crores annually at today's prices.

The planners have been conscious of energy wasted in our industry, mostly due to obsolete and energy inefficient technology. The Planning Commission has identified considerable scope for improvement in energy efficiency which will result in saving of equivalent of 3000 MW installed capacity and Rs 7000 crores at 1989-90 prices. The industries identified for this exercise include fertilizer, cement, steel, aluminium and petrochemicals which will have 4% to 55% less energy consumption for the same output-based on scale, technology and capacity use.

According to Dr R K Pachuri, President of International Association of Energy Economics and Director, Tata Energy Research Centre, India should adopt new energy strategy with effective demand management and energy conservation measures. According to him, long term outlook for renewable energy technologies in India remain bright. This requires well directed investments in this field in the Eighth Plan.

Telecommunications

The Department of Telecommunications has drawn up a big plan for improving telephone services. STD or direct dialling facilities will be extended to all the district headquarters by the end of the Seventh Plan. During the Eighth Plan, the facility will be further extended to all the district headquarters and towns having 500-line telephone exchanges. For meeting the requirements of commercial and business subscribers and industries in rural areas, the Department has planned to provide a satellite based remote area message network.

The qualtity of service is to be improve by installing incremental investment in technology upgradation like establishing digital radio and microwave links; inducting optical fibre system; increasing availability of public telephones from 44000 to 60000, telephones for trunkcalls from 1500 to 3500 for STD calls from 700 to 7000, and the target for telegrams 99% delivery within 24 hours.

Electronics

The electronics industry is poised for a significant break-through with confidence to reach a target of Rs 1 000 billion annual production target by 2000 AD and Rs 10 billion in 1990 from Rs 53.25 billion in 1987-88.

Informatics

Computers add value to data information thereby providing a flexible tool for looking at and finding workable solutions to a variety of problems like removal of poverty, health care, demographic studies, population control, urban and rural planning, HRD, man-power planning, etc.

These problems are no longer pertaining to physical systems alone but along with human systems and social institutions. These problems have many variables and are, therefore, complex. We need to make extensive use of computers and information technology for dealing with these problems.

The report submitted by the Bureau of Industrial Costs and Prices on the Informatics Sector, which has a vast export potential, highlights that in building international competitiveness, there are four important issues, viz, (i) Quality Control, (ii) Standardization, (iii) Man-power training, and (iv) Technological Upgradation.

Urbanization

A concrete action plan for coping with urbanization would be included in the Eighth Plan. It will include fresh policy initiatives toward urban management with involvement of local bodies. The National Housing Policy Document outlined specific steps to tackle critical housing inputs like serviced land, finance, building materials, technology and legal and institutional frame work.

Housing

The Working Group on Housing set up by the Planning Commission to assess housing requirements in the Eighth Plan for different groups of people, particularly the poor in both rural and urban areas, five sub-groups— two for considering role of facilitators on housing and housing finance and three others, will discuss issues relating to rural housing, land policy and magnitude of housing problem.

The working group will review performance in Seventh Plan and focus on the extent of success or failure in achievement of targets and estimate physical and financial targets for investments in housing will specifically study problems of slum-dwellers and squatter settlements to devise appropriate programme for shelter upgradation.

The following table gives Planning Commission's estimates of housing (urban and rural) shortages:

	No in millions		
Year	Rural	Urban	Total
1951	6.5	2.5	9.0
1961	11.6	3.6	15.2
1971	11.6	2.9	14.5
1981	16.1	5.0	21.1
1985	18.8	5.9	24.7
1990	22.3	6.9	92
2001	29.8	9.3	39.1

Industry

The steel industry consists of six integrated plants (seventh under construction) and 16 odd mini-steel plants.

The industry has drawn up its own modernization and technology upgradation plan. SAIL's modernization and expansion scheme involves an outlay of Rs 15000 crores to raise saleable capacity to 15 Mt. TISCO has similar gigantic plans for modernization. The mini-steel plants also need modernization increasing size of electric furnaces, increasing transformer rating, use of concast and auto control of processes.

Shri J Vengala Rao, Union Minister for Industry, called upon non-electrical machinery sector to achieve high growth rate by better and intensive utilization of existing Capacities and resources. In view of the crucial linkage of this sector with the rest of the economy, the industry should take advantage of various liberalization measures.

The Eighth Plan will give special attention of textile, cement, fertilizers, petro-chemicals, crude oil and sugar industries. This will include incentives for modernization and technology upgradation to achieve improved efficiency norms and focus investment effort on selected sectors instead of spreading resources thinly.

In October 1988, the Government announced details of the technology, finance and development scheme being impleted by the Risk Capital & Technology Finance Corporation (RCTC). The thrust areas identified are projects having export potential, industries in the forefront of S&T research, App. I industries and industries which have a significant impact on the country's economy. The scheme is expected to accelerate the pace of technological progress in quality.

In its efforts for faster industrialization and decentralization of industry, the Government of India has planned to set up 61 growth centres each with an investment of about Rs 30 crores for development of infrastructure. A comprehensive scheme to use plastics in a big way in agriculture and food packing is being launched to conserve wood and protect forests. Use of plastics in agriculture will lead to tremendous saving of scarce water resources.

There is a vast scope for technology upgradation in small scale industry which is deriving more importance and relevance with pressure on costs and profitabilities of large and medium scale industries in the organized sector.

SIDO has so far covered only 637 out of 1.6 million units by March 1987.

SBI and SIDO have a major role to play in developing technical capability, quality consciousness of industries in district industry centres — higher productivity and sustained quality standards — we should promote and develop them to use BIS marking as compulsory quality control measure, eg, household electrical appliances.

The Planning Commission is adopting a new strategy for the Eighth Plan projections in agriculture and allied sectors with separate working groups for each category of irrigated area, rain-fed and dry land area. For each category, plans will be prepared for each state both for land development and for cropping pattern as well as for support mechanism.

Plans are being drawn up for rural industrialization on the basis of locally available materials, eg, fruit and food processing and development of horticulture, vegetable growing, prawn and fish farming and bee cultivation through IRDP loans. In the last eight years, IRDP has provided assistance to 28 million families with an investment of over Rs 9400 crores.

Small scale units in rural growth centres will be encouraged with emphasis for training of rural youth for self-employment (TRYSEM) — financial and other incentives will be given for industrialization through such self-employment.

Manufacture or assembly of modern items where demand is not a problem can also be set up in rural areas.

Shri Sam Pitroda has drawn up a 10-point action Strategy for employment through entrepreneurship. A national level organization is proposed to be set up to promote marketing of goods produced under Integrated Rural Development Programme (IROP) and give guidance, support and consultancy services.

The National Employment Guarantee Scheme is being studied for its feasibility. ICAR is planning schemes for large scale gainful employment of rural women by studying the role being played by women in agriculture and different farming systems.

There is a vast scope for industrialization in new areas like biotechnology for high-yielding, disease-free planting material, hybrid seeds of different foodgrains and vegetables.

The technology mission on oil seeds has recently observed that we lose annually about 500000 t of edible oil valued at Rs 1000 crores due to inefficient processing facilities. The mission has drawn up a detailed programme to develop integrated processing technology, increase oil recovery, improve *Ghanis* and expeller units and thereby quality of cakes and extractions.

Transport

The Planning Commission, while reviewing the transport sector, has suggested restructuring of pricing structure based on comparative resource costs. In view of resource constraints, each transport undertaking should generate enough internal resources to cover capital costs and contribute to its development. This will mean moving from administered prices in public sector transport pricing. in the current resource crunch, priority should be accorded to those areas which will contribute to the industrial and economic growth of the country. Freight transport has, therefore, to receive a higher priority.

The passenger and freight traffic is expected to double by the year 2000 AD. This has to be done by capacity increase, technology upgradation, integration with other transport modes and chalking out investment priorities.

Development of road transport, planning and development of heavy and light commercial vehicle industry need similar detailed review of needs, gaps, technology upgradation needs, alternative models, resources required and how to generate them.

The above Plan targets bring us to think seriously on the following issues:

it is appropriate to do planning of each sectoral area and assess the financial and physical resources required. As identified by the Planning Commission's initial studies, there will be a large resource gap. The FICCI study has shown that with a planned financial discipline and close monitoring of capital investment, it will be possible for us to better the projected growth rate of 6% to even 7%.

The new wave of enthusiasm and short term successes achieved by private and public sector industries give us further confidence that this is within our reach. The C-Dot experiment has shown that a planned, integrated approach to every sector, considering it as a mission and task oriented approach, can help us to succeed in a relatively short time. The experience is being transplanted into five missions with confidence and dedication of few committed individuals.

We have skilled and unskilled man-power, a large national market and natural resources. There are no economic impediments to industrial growth.

We should be able to learn ways and means of doing it form few fuccess stories. Human capacity to devise new ways and means and achieve what looks impossible at the beginning is enormous. There is a healthy climate in the country. Political and social stability is, perhaps, at its best. Late Prof Raj Krishna considered growth, investment and poverty as most critical. He said: 'Administrative revolution and policy revolution are preconditions for success in achieving the desired growth rate.'

In India, with resource crunch, it is the basic responsibility of engineers to ensure that the nation gets results with every rupee that is spent. If I remember right, late Vikram Sarabhai said once that we spend much in the sense that a lot of money is wasted due to poor workmanship, use of sub-standard materials, etc and we thus bum the candle at both ends, so to say. It is not only the resources crunch that is the bane of developmental process but wrong priorities and wastage of money which are equally greater problems.

In a national broadcast in 1982, Sm Indira Gandhi said: 'We must get more under every acre ploughed, out of every spindle and machine, out of every technologist and worker, out of every rupee spent.'

We need to raise production of every input, be it scarce raw materials or costly machines or men and, above all, the capital substantially to reduce the capital output ratio from 6 to 5. The comparison with international norms shows that there is a scope for increasing productivity, reduce wastages, improve quality multifold. The exercises currently in hand all aim at drawing detailed action oriented plans with involvement of States and decentralized planning processes. Here lies the scope and hope for a success!

False optimism might induce complacency; inflated pessimism may induce fatalism. Let us, therefore, hope that this will be the Eighth Plan and not the eight version of the same Plane.

From the detailed anlaysis of the inputs that have gone into the finalisation of the expected growth rate, detailed studies of resources, gaps, strategies, actions and mocro analysis of various issues and problems at the State and district levels, one can note that there is an action oriented plan being prepared. These detailed studies can guide us to specific actions required in every sectoral area and the role the engineering fraternity in general and the Institution of Engineers (India) in particular can play.

A minute observation of these plans further shows that in every sphere of activity, the engineering community can make a tremendous amount of contribution. Most of the investment estimates are based on past experience. Many studies by technocrats, comparison of norms with industries abroad, the experience of industry within the country in the past two or three years and their success stories in increasing productivity and internal resources by leaps and bounds by simple but effective measures have shown that taken the right actions with freedom in decision making, decentralization of decision making, close monitoring of various activities and, above all, working together of various sectors of the economy can help us even to achieve 7% growth rate.

EXPO 85 in Tokyo on the theme of 'Dwellings & Surroundings — Science & Technology for Man at Home' showed the direction the world is taking towards a more harmonious and affluent 21st Century. The theme of IBM (Japan) Pavilion was 'Spirit of Science—Heritage to the 21st Century' which signified that scientists and technologists are results of man's intellectural activities through the ages and they form basis of human life today. Significant progress in these two areas has transformed, among other things, our industries and our homes and hold great promises for a more rewarding society in the future. It further shows that we need to grasp the spirit of science and the roots of our complex, increasingly sophisticated scientific technology to have a clear image of the texture and quality of life in the next century.

The world is planning to advance at a very fast rate towards the 21st Century. We in India have to establish that the achievements of science and technology and large technical man-power available in the country can help Indian population to enjoy the fruits and benefits of the world development of increased, complex and sophisticated science and technology.

We in the Institution with 15 disciplines, nearly 75000 corporate members, 90 centres at state capitals, major towns and industrial areas, with international rapport and capacity to conduct over 2000 technical activities like lecture programmes, continuing education courses, workshops, seminars, symposia, national and international conferences, specialized activities of our forums and the Engineering Staff College, can participate in the formulation of the Plan Document and later its implementation at State and district levels. In the past, we have had dialogues with the Planning Commission, other governmental agencies and industrial bodies on what role the Institution can play. Let us again offer all our facilities and man-power in making this task a great success and face the challenges with full confidence.

Let us plan to give help to the leaders in building this confidence in science and technology and the large technical man-power to deliver goods and services for the uplift of a large portion of our population and improve the quality of their life.

We have amongst us many Council members as well as corporate members who are already taking part in Plan development and implementation. May I request all my colleagues in the Council, in State Centres and other centres to deliberate on these thoughts and discuss them at meetings in the centres and direct our activities in the next year in making the Plan a real success, contribute the Institution's mite in nation building and gain due recognition for the engineering fraternity.

Shri P R Bapat—a Brief Profile

The National Council of the Institution of Engineers(India) is proud to announce the election of Shri Prabhakar Ramachandra Bapat, BE(Elec), BE(Mech), DIM, FIEE, C Eng(UK), Sr MIEEE, C Eng, FIE, as President of the Institution for the session 1989-90. He will take over this high office from Shri K M Chakravorti, retiring President, at the Third Indian Engineering Congress to be held in Madras on January 22, 1989.

Shri Bapat brings to the Institution a wealth of knowledge and professional experience as an industrial leader. Shri Bapat who is presently Chief Executive, Projects and Technical Services, Guest Keen Williams Ltd, has had over 30 years industrial experience in research and development, project management, technical and economic feasibility studies, planning, evaluating and implementing modernization and technology upgrading, improving cost effectiveness and competitiveness, and securing foreign collaborations. He has been rendering active service over the years at national, regional and state level to engineering and management institutions, education and research institutions, professional bodies and industry associations.

Shri Bapat has also distinguished himself in management studies. He is teaching management policy, operations research and production management as an Honorary Visiting Professor of JB Institute of Management Studies, Bombay University, for over 16 years. He was a member of a three man management team sent abroad to study investment opportunities and was deputed to work for GKN group of companies in the United Kingdom under Executive Exchange Scheme. A keen promoter of the cause of engineering and management studies, Shri Bapat is an active member of various learned and professional societies. He is a member of the Board of Management of National Institute for Training in Industrial Engineering (NITIE), Bombay; Victoria Jubilee Technical Institute (VJT), Bombay; Sardar Patel College of Engineering, Bombay; Shri Bhagubhai Mafatlal Polytechnic, Bombay; Sir Visvesvaraya Regional College of Engineering, Nagpur; Shri Guru Gobind Singh College of Engineering, Nanded; Cusrow Wadia Technical Institute, Pune; Agnel Technical College, Bombay; Study Committee of Konkan Technical University; Technical Teachers' Training College, Bhopal; and many other colleges. He is a member of the Board of Technical . Examinations, Government of Maharashtra; a member of the All-India Council for Technical Education, Government of India, Western Region; Chairman of Expert Committee of Western Regional Committee for Establishment of Staff College for Management of Technical Institutions in Western Region; Chairman of Government of Maharashtra Study Committee (Bapat Committee) appointed to study existing teaching and examination systems and to suggest improvements and implementation plan for polytechnics in the State; Chairman of Committee of Courses in Production Engineering, Board of Studies, Government of Maharashtra; a member of Board of Apprenticeship Training, Western Region, Bombay 1974-78; Chairman of Curriculum Development Committee, Agnel Technical College; and Chairman of many other committees for review of technical education in Maharashtra State.

A champion of the cause of developing a management culture in the country, Shri Bapat is the Chairman of Western Regional Council and Regional Vice-President of the All-India Management Association. He was the President of the Bombay Management Association (1986-87); and the President of the Bombay Productivity Council (1983-85).

Shri Bapat is an engineer with a truly multidisciplinary background. His engineering degrees are in electrical and mechanical engineering. He is President of the Magnetic Society of India; Member of the International Board, Institution of Electrical Engineers(1983-86) and its Overseas Representative(1982-87); Chairman of Institute of Electrical and Electronics Engineers, Inc, Bombay Section(1986 and 1987); and Life Member of Operational Research Society of India.

His contribution to industry is also noteworthy. He is a member of the Confederation of Engineering Industry, Western Region and is also Chairman of its Energy Committee. He is also the Chairman of Stampings and Laminations Division, Indian Electrical and Electronics Manufacturers' Association; a member of Executive Council, IEEMA; a member of Bureau of Indian Standards; and the Vice-President of Electrical Research and Development Association.

Author of many research and practice-Oriented papers, his paper on 'State-of-the Art on Magnetic Materials in India,' for the Development Council for Heavy Electrical Industry, Government of India, *is a monumental work on the-subject. He has also published a large number of papers on engineering and management subjects. He has also assisted social organizations for rehabilitation of leprosy patients and has undertaken tours of scarcity areas in Maharashtra and organized relief work during natural calamities.*

Actively involved in the affairs of the Institution for over a quarter century, Shri Bapat was Chairman of the Maharashtra State Centre (1973-74). He is at present a member of the National Council elected from the Electrical Engineering Division and is also a member of the Finance Committee in which position he has been involved in strategic planning of the Institution finances for many years. He is responsible for planning and organizing a large number of Seminars, Conferences, Round Tables, Continuing Education Courses and other technical activities as Convener/Organizing Secretary on behalf of the Institution.

An eminent personality in the engineering profession with profound dedication to the cause of progress and advancement of the members of the engineering fraternity, Shri Bapat brings a new dynamism to the Institution. His election is sure to make the profession stronger and enable it to contribute in more and better ways to the welfare of the nation. The profession fervently looks forward to his enlightened leadership, guidance and support in its continuing efforts to serve the nation.

Dr H C Visvesvaraya

President 1990-91

Presidential Address

OBEISANCE

This great Institution has had a glorious past. Our past achievements have had a great impact on the quality of life in our society in general and on the engineering profession in particular. Every Indian can be proud of our achievements over the last nearly seventy years. These achievements have been the result of the efforts of many. Besides the thousands of members, these include the great Statesman-Administrator-Engineer Bharat Ratna Dr M Visvesvaraya, who was an Honorary Life Fellow of this Institution and as Past Presidents, Dr A N Khosla, an engineer par excellence and former Governor of this very State (Orissa), Dr Triguna Sen and Dr K L Rao, engineering luminaries and former Union Ministers. There has been a similar chain of eminent personalities as past Presidents, the names of all of whom this occasion does not permit me to list. I am happy that some of them are present here. On assuming this highest office in engineering profession, I begin by paying my respects to these great elders whose foot-steps I am now privileged to follow. I am indeed grateful to the National Council of the Institution of Engineers (India) and to the members of the engineering profession whom the National Council represents, for the great honour they have done me by unanimously electing me President of the Institution.

ROLE OF ENGINEERING IN SOCIETY

The terms 'science and technology' have lately come into common usage in the world and quite often 'engineering' is assumed to be covered under this broad term. A scientific and technological base is undoubtedly an essential prerequisite for 'engineering', but science and technology are not the only constituents of engineering; the economic and social aspects are its equally important constituents. Science observes, discovers and formulates the laws of nature. Technology deals with the means of application of the principles of science. Engineering converts the resources available into actual goods and services needed by the society, giving due weightage to all the parameters involved — whether they be in scientific, technological, economic, social or even political realms, by properly synthesizing them all towards a realistic and optimal solution in each case. The Engineer is thus a convertor of available resources into meaningful and concrete wealth for the benefit of the society.

While society requires a variety of human endeavours — political, social, legal, economic, engineering, medical, scientific, and so on — the more and more dominant role that engineering has come to play in the modern world has given it an especially important place in our society. Whether it, is harnessing the resources of nature for the service of the society or converting the most modern scientific findings into outstanding technological achievements of value to the nation, engineering holds the key.

ENGINEERING ACHIEVEMENTS — A GLIMPSE

India's development scenario is an eloquent testimony to the achievements of her engineers over the past four decades.

Our foodgrains production which was a mere 51 million tonnes at the time of Independence, is expected to touch 178 million tonnes by 1989-90. This has been aided in no small measure by the planning and construction of hundreds of ani cuts, dams, canals and tube-wells, resulting in expansion of the area under irrigation from 21 million hectares to 80 million hectares, making India a country with the second largest irrigation network in the world. The progress in agricultural engineering has been no less impressive with the manufacture and use of a wide variety of modern farm machinery like tractors, power tillers, threshers, harvesting combines and so on. In relation to clothing, we are about to reach a target of 14.5 billion metres of cloth in 1989-90, as compared to 4.2 billion metres in 1950-51. In the matter of housing, about 61 million houses have been added since Independence.

Steel production which stood at 1.5 million tonnes at the time of Independence, is poised to touch the 12.6 million tonne mark in 1989-90; cement, from 2.7 million tonnes to 49 million tonnes putting India in 6th place among the countries of the world; coal production from 33 million tonnes to 226 million tonnes; oil from 0.26 million tonnes to 34.5 million tonnes, and electricity from 5.3 billion kWh to 295 billion kWh, placing India as the 11th among the countries in the world.

Quite apart from these brief glimpses as related to basic human needs of food, clothing and shelter, and the basic measures in terms of materials and energy, a review of India's progress in the last four decades clearly brings out the spectacular success we have achieved in practically every facet of national activity — whether it relates to creating infrastructure including roads and railways, constructing border roads in some of the world's most difficult terrains at inhospitable heights or in building plant and machinery; our radio and television networks as well as telex, telephone teleprinter and now Fax have made remarkable progress; advances in space technology providing our own satellites have not only put India in the exclusive club of the countries having their own satellite but also brought about many engineering advances; the achievements in nuclear engineering such as in power stations, industrial radiography, medical diagnosis and treatment, cyclotron irradiation in food and agricultural fields are remarkable even by the standards of the countries developed in atomic energy; development of integrated guided missile, combat aircraft, battle tank, electronic survillance systems and so on is indicative of the engineering capability and achievement as related to our defence. India's achievements in ocean engineering have invested the country with the potential to harness

Antarctica's marine and mineral resources; the progress in genetic engineering has paved the way to new vaccines, treatment for cancer etc. Development of data bases, software and expert systems, have placed India amongst some of the most advanced countries in certain computer-related fields.

When we take a comprehensive account of our engineers' achievements so far, we could all indeed be justifiably happy and proud.

ENGINEERING CHALLENGES—AN OUTLOOK

However, when, we consider the complexities of our present-day problems and the challenges of the future, we will at once realize that there is no room for complacence. For all the planned development we could achieve through the seven successive Five Year Plans and the tremendous progress registered in a variety of areas, we have not yet been able to conquer poverty, remove unemployment, eradicate disease, or banish illiteracy; social disparities and consequent tensions in the society have continued unabated. We have yet to fulfil many needs, both quantitatively and qualitatively.

To begin with, the industrial development which has turned the face of our country is presently concentrated mainly in metropolitan and urban regions; a large part of rural India is yet to have industries. The Rural Development Forum established by this Institution has been promoting and advancing the science and practice of various branches of engineering for rural development through a number of dynamic programmes.

By the year 2000 AD we have to increase food production from the present level of about 178 million tonnes to about 240 million tonnes. To do this, the irrigated area which is presently around 80 million hectares, will have to be increased to about 113 million hectares, for which many more river valley projects will have to be completed. The engineer has the responsibility of not only irrigating but also of providing the required inputs to increase the output of the land; this would include putting up additional fertilizer plants and providing improved agricultural implements and machinery.

Whilst we are well on our way to meet the required foodgrains target, the management of available water resources has yet to be improved a great deal. There are threats of floods and droughts and imbalances in water utilization. The Water Management Forum of this Institution constantly studies and reviews the water resources and recommend appropriate measures for efficient utilization of this all important natural resource.

Cloth production has to be raised from its present 14.5 billion metres to 21.6 billion metres by the turn of the century. In addition, qualitative developments taking place in textile engineering have to be caught up with.

Whilst meeting the future challenges of food and clothing appear to be within our reach, that of providing shelter to the millions seems still far off. Already the shortage of housing is about 41 million units. To fully meet the demand for housing in this country we need to put up another 81 million units within the next ten years; such a large gap can never be bridged by carrying on our housing progress at the present rate of hardly 2 million units per year; even if this is doubled or trebled, by the time the backlog is cleared, new demands would have generated. The challenge before us is, therefore, one of mobilizing more resources on the one hand and increasing the speed on the other; this may be achieved either through industrializing housing construction or through extensively socializing housing by providing the needed inputs in a very widely distributed but systematic manner or better, by a combination of the two approaches. Quite apart from the quantitative needs, there is also an urgency for meeting the qualitative needs. Out of the present stock of housing, 38 million units are kutcha, 38 million units are semi pucca and only 43 million units are pucca. We have to move faster to take the kutcha category into semi pucca and pucca, and the semi pucca to the pucca category. In doing all this we have also to keep

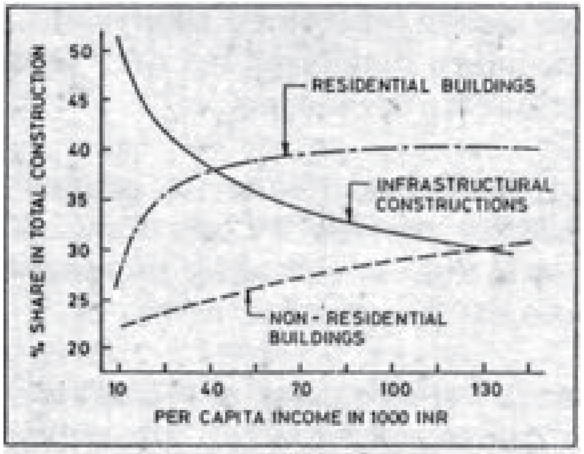


FIG. 1
TREND OF SHARE OF RESIDENTIAL, NON-RESIDENTIAL AND INFRASTRUCTURAL CONSTRUCTIONS IN TOTAL CONSTRUCTION

in view the general trend of the mix in the construction sector (Fig 1) which clearly shows that housing takes a larger and larger share in the total construction as development progresses.

In terms of basic measures of economic growth, even on the basis of our own plans and projections, without reference to other countries, by the year 2000 AD,

the energy output has to be increased from 295 billion kWh to 594 billion kWh;

steel output from 12.64 million tonnes to 21 million tonnes; and

cement output from 49 million tonnes to 87 million tonnes.

Even with these great advances we shall only be marginally improving our position vis-a-vis many other countries (Table below),

PER CAPITA STATUS OF INDIA VIS-A-VIS SOME OTHER COUNTRIES
1988

Item \ Country	India	Canada	China	France	Japan	South Korea	U K	U S A	U S S R	West Germany
Food grains (kg)	215	2240	309	874	129	196	427	1184	635	384
Electricity (kWh)	355	18845	489	6541	5440	1549	5664	10964	6010	6245
Coal (kg)	272	1487	857	217	91	534	1818	3590	2112	1296
Crude Petroleum (kg)	41	3054	124	60	5	40	2080	1537	2217	64
Cement (kg)	59	459	185	452	590	704	207	290	486	516
Pig iron, Ferro alloys (kg)	15	366	53	262	656	304	219	178	403	514
News print (kg)	0.4	384	0.2	6.6	25	9	9.7	22	4.4	14
Per capita daily intake										
Fats (g)	34	156	35	162	83	40	143	167	98	153
Proteins (g)	51	98	61	108	92	77	87	106	107	91

Similarly, we have to lay another one million km of roads and 10000 km of railway track even to meet the minimum essential needs by the year 2000 AD. We have also to establish 74.15 thousand exchanges and 24.29 million telephone connections both in urban and rural areas, as compared to the present number of about 14,000 exchanges and about 3.93 million telephones.

Yet another major challenge ahead is to meet more adequately the growing requirements of energy in the rural areas. Intensified programme of rural electrification is needed. Viable renewable energy sources have to be developed. Ocean energy and geothermal energy could also be developed in selected regions. Bio-gas and biomass would also make a significant contribution to meeting the energy requirements of rural areas.

Engineering skills have to be directed not only to provide the goods or services needed by the society, but more importantly, to provide them consistent with gainful employment to the largest section of the society.

In India, considering both, direct and indirect expenditures in public as well as private sectors, engineering activities have accounted for as much as 70 to 75 per cent of the total Plan outlay. Quite apart from the magnitude, engineering tasks are also complicated. These together make the engineers' tasks even more challenging.

MEETING THE CHALLENGES—AREAS OF SPECIAL THRUST

To meet these challenges ahead of us, we have to set the direction and, work out proper strategy for carrying out our engineering activities. This exercise would lead us to the following areas of special thrust:

- Environmental Protection including Ecological Balance;
- Materials Conservation including Performance Maximisation;
- Energy Conservation;
- Safety Assurance - both health and hazards;
- Cost Reduction - both immediate and life-cycle;
- Manpower Optimization;
- Speed Compatibility; and
- Ergonomic and Aesthetic Satisfaction.

Environmental Protection Including Ecological Balance — Even though human environment has received, attention since the dawn of civilization as evident from ancient scriptures, with the pressures of industrialization combined with that of increasing population, this aspect had gone somewhat to the background. The UN Conference on Human Environment held in Stockholm in 1972 however brought it back to focus; the three dimensions of environment — ecological degradation, environmental pollution, and resource depletion, started receiving focussed attention. For an engineer, ensuring a satisfactory living environment is as important as providing goods and services for improving the quality of life.

We degrade the earth's crust in India to the extent of as much as over 5,000 million tonnes a year for securing the raw materials for our engineering activities. For example, to secure 2.2 million cubic metres of timber last year we have damaged 400 thousand hectares of forest; in 1952 we had about 23 per cent of our total land area under forest cover; today it is down to10 per cent. Large scale deforestation could lead to increased floods, soil erosion, silting of rivers, contraction of agricultural production areas and eventually desertification. To produce 65,000 million bricks we have degraded 55,000 hectares of fertile land and for winning I various .other minerals more than 20,000 hectares have been degraded. On the other hand, we produce some 2,500 million tonnes of solid wastes — about 450 million tonnes a year from agricultural, about 250 million tonnes from industrial, and about 1,800 million tonnes from rural and urban activities. A recent study has indicated that the main chemical constituents in these solid wastes are the same five major elements which constitute 91 per cent of the earth's crust. One of the primary Challenges to the engineer in the years to come would be to convert these wastes into wealth so that the environmental and disposal problems relating to these wastes are solved, and at the same time, degradation of earth's crust is reduced.

Other environmental issues of concern are radioactive fall-out from nuclear testing, nuclear plants, long-term storage of nuclear materials, and disposal of nuclear wastes; increasing concentration of carbon dioxide in the atmosphere due to the large scale burning of fossil fuels in modern industry and transport systems, leading to the 'green-house effect'; the phenomenon of 'acid rain' and the warming and melting of polar ice caps; fluorocarbon exhaust from aircraft, aerosol sprays and refrigeration thinning out the ozone layer and leading to a greater penetration of ultraviolet radiation over the earth with consequent damage to many food crops and even health problems.

Materials Conservation including Performance Maximisation — From the above, the need for materials conservation is obvious. For securing maximum benefit from a given material, its performance has to be maximised. With a deeper knowledge of materials science it is now possible to get high-performance as well as lighter-weight elements for a variety of engineering applications. Even a simple mineral like limestone, when put through one type of thermal regime, gives ordinary building lime, and through another, ordinary portland cement which is a much higher performance material. Engineers will have to give special thrust to conserve and use relatively less materials and relatively lighter weight units.

Energy Conservation — Although philosophically energy and material are interchangable, there is a global limitation of energy from practical considerations. For example, out of the total energy available, about 76 per cent is used by 21 per cent population living in industrialized countries, leaving a meagre 24 per cent for catering to the 79 per cent inhabiting the developing world. It has therefore become a prime concern of engineers to conserve energy in all their activities. Energy Audit and Energy Management have become priority items on their agenda.

Energy, Mass, and Environment — are indeed interrelated in the system, each having an interaction on the other (Fig 2) which would also have to be kept in mind in pursuing any activity.

Safety Assurance — Globally over 50 million people suffer occupational injuries every year, of which nearly 100 thousand are fatal. Some 70000 accidents take place in our road, rail and air

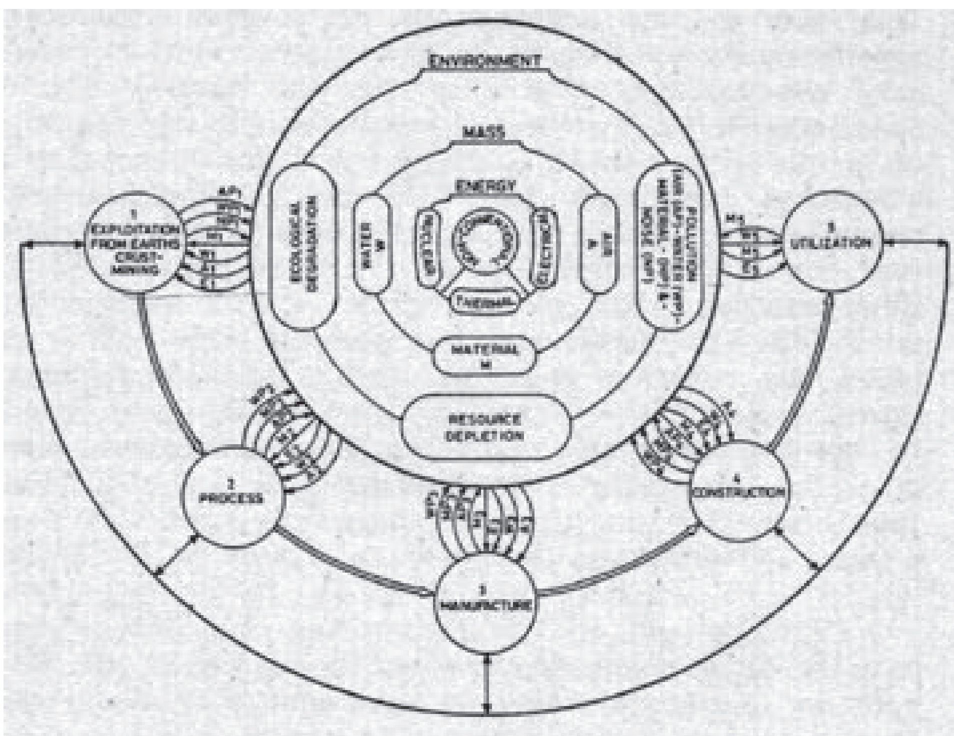


FIG. 2
ENERGY - MASS - ENVIRONMENT BALANCE

transportation systems every year and 3000 accidents in our mines. Contrary to popular belief, most big accidents and disasters have in fact taken place due to seemingly minor acts of negligence or malfunctioning of relatively small devices or components. For example, the official review board has pointed out that a major factor in the failure of the American Space Mission Apollo 13 in April 1970 was the lack of coordination of two Standards; the specifications for a heater in the oxygen tank were revised in 1965 but concomitant changes in the specifications for thermostatic switches were somehow overlooked; this led to overloading, scorching off of insulation, short-circuiting, fire and explosion. This was a case where, out of several hundreds of specifications used, lack of proper interrelation between only two resulted in a disaster. The disaster that the Space Shuttle Challenger met in 1986 was due to the failure of a pressure seal less than 8 mm in diameter. The Chernobyl disaster in 1986 was due to blockage in the heavy water pipeline leading to overheating of nuclear fuel rods. The 1975 disaster in the Chasnala Mines in Bihar was due to the wall thickness between the abandoned mine full with water and the working mine having gone below the minimum required norm of 60 m, and even the latest accident at Mahavir Colliery in Raniganj was due to non-avoidance of subsidence and consequent gushing of water. The tragic disaster due to leakage of MIC in the Union Carbide Plant at Bhopal in 1984 was due to a faulty valve and non-functioning of certain safety devices.

Although in the United States and Japan, robots have replaced manual operation to the extent of 55 per cent in dangerous work, 59 per cent in harmful work, 45 per cent in laborious work, 70 per cent in monotonous work, and 36 per cent in workpiece loading and unloading, there have been cases of serious accidents due to improper maintenance and nasty faults. Safety engineering goes not only into operations which can safely be replaced by robots, but also into making the robot system itself safer. Safety engineering has thus become one of the most complex engineering disciplines.

Cost Reduction — The need for cost-effective solutions and cost reduction in any given situation is fundamental to the engineering profession. But it is not· uncommon to find that in order to make do with the available resources, immediate costs of projects have been reduced, creating sometimes a bigger long-term liability to the society. For example, it is no use providing a low cost housing or a low cost pavement on a road whose lifecycle cost is high; it would then mean that the present generation is creating a liability on the future generation. Whilst the low cost solution may have to be resorted to when the funds or resources available at any given point of time are limited, and satisfaction has to be provided to the largest number of members in the society, it would be the engineer's responsibility to optimise both the immediate and the life-cycle costs in arriving at a final solution.

Manpower Optimisation — We already have 42 million educated active population with a total work force of about 632 million, and by the turn of the century this is likely to go up to 65 million and 790 million respectively. In a situation like this, models which have been found appropriate in some other countries are not necessarily the most appropriate ones under our conditions. There is no doubt that we should take the fullest advantage of advances in science and technology, modern mechanisation, automation, instrumentation and computerisation systems, but at the same time we have to be judicious in harmonising these with the optimum use of the manpower available to us. This would call for un-conventional solutions. With advances in microprocessors, electronics and communications, it is now possible to have operational units on a small scale which can be just as modern as the ones which are large and mass-producing. And there have been instances where such small-scale units have been put up at a much lower capital investment with optimum manpower utilization and which are producing goods and services in no way inferior to — indeed even better at times — than the most modern automated and computerised giant size units.

Speed Compatibility — Engineering solutions, in order to meet the challenges, have to be speed compatible. Neither should they provide for such high speed as to lead to idle capacity, nor be of such a speed as to make it impossible to reach the desired objectives. For example, in meeting the shortage of housing, as I stated earlier, an industrialised approach to building construction may be a solution an engineer can provide to bring speed compatability and this would mean change in the entire line — change in materials and in components, change in machinery, change in method and change even in contract conditions.

Ergonomics and Aesthetic Satisfaction — Conformity to the good principles of ergonomics is important not only for achieving maximum productivity but also as part of social responsibility. To create goods and assets which are aesthetically pleasing would also make for a happier society. These considerations cannot be ignored in the agenda of the engineer, whatever may be the complexity or urgency of the task at hand.

STRENGTHENING SUPPORT SERVICES

In order to achieve the above thrust satisfactorily, in addition to the major area concerning Human Resources Development, appropriate support services have to be secured by way of :

- Information;
- Productivity;
- Standardization and Quality Systems; and
- Research and Development

Information — Whether it be in securing or utilizing knowledge, or in acquiring skill, information of the right kind at the right time in the right dose is essential. Some sixty million technical books constitute the corpus of engineering knowledge, which is being expanded at the incredible rate of almost a thousand a day; in addition about 150000 special journals are published every year — 35 per cent of them carrying some 4 million articles dealing with subjects having a bearing on engineering. It is estimated that by the end of the present century, the total number of journals of interest to engineers published would reach nearly one million. Thus the system of collection, compilation, storage, retrieval, translation and transmission of information is perhaps one of the most stupendous tasks in the development and transfer of knowledge and skills of engineering.

But the engineer's needs extend beyond what is provided as information in the form of mere literature and documents. He has to have at his disposal systems which would, in addition to the above, also deal. with the knowledge available in the form of drawings, specifications, standards, patents, project reports, feasibility reports, construction reports, design development models, photographs, films, etc. Therefore, engineering information with its own components, hitherto not handled as a special discipline, needs to be given special attention.

Productivity — On productivity, Mahatma Gandhi observed "What is productivity but making the most of one's time and talent, and energising the whole surrounding environment so that men and women are inspired and motivated : that is make the most of themselves, both as individuals and as members of society on all planes of living, thinking and acting : whether it is politics or economics or home or village or factory, life at the ground level or life of the spirit".

Whilst the basic meaning of productivity has remained the same, its content and implications are getting continuously adjusted or transformed depending upon the environment. In the case of an industry, for instance, 'total factor productivity' would consist of parameters, such as capacity utilization of the plant as a whole; rate per hour of unit operations; energy utilization — electrical and thermal; raw materials consumption; maintenance productivity; labour productivity and productivity in terms of quality.

Engineers' role in improving productivity has many new dimensions. In developing economies, where capital is scarce, it is of utmost importance that the capacities already established are utilized to the maximum. In place of capital intensive methods generally resorted to in developed economies, engineers in developing economies have to find more and more software based approaches. The fruits of advances in science and technology should be brought· to bear not only upon the relatively newer and more modern plants but in an appropriate manner on the old plants as well since many of our old plants cannot just be discarded or replaced in a short time. Developments in science and technology have also to be taken to the workers by incorporating specific programmes which would motivate and develop them to better themselves intrinsically and also better the work they are doing.

Pooling of technology support services and pooling of certain capital intensive equipment and other facilities for leasing, specially to engineering projects too small to own them on a captive basis or whose need is intermittent, are becoming important ways of providing both hardware and software technical back-up in modern engineering endeavours and for raising their total factor productivity.

Standardization and Quality Systems — Standardization being an integral part of orderly development, forms the base for sound engineering practice. Perhaps very few know that the Institution of Engineers (India) played a pioneering role in starting the standardization movement in this country in the 1940's. As a result, India today has one of the strongest national .movements in standardization in the Bureau of Indian Standards (BIS), which is the successor to the Indian Standards Institution.

Whilst BIS has already brought out nearly 15000 National Standards, many of which are of relevance no the engineering profession, the important role played by other levels of standards such as association standards and company standards, has not yet been fully appreciated. The success of the engineering profession is closely linked with the success we achieve in taking the standardization movement forward at all levels.

Whilst a lot is talked about quality, for most sections of our society, quality means just the testing of a product and its eventual acceptance or rejection. A logical corollary to the laying down of standards, is ensuring conformity to them. Accordingly, testing of finished product for conformity was first introduced. This old concept of 'policing quality' was replaced by the more progressive concept of 'fostering quality' through certification marking schemes such as the one covered by the ISI Certification Marks Act which involved a third party inspection, testing and certification. Today, 'growing quality' in a product or service involves much more. Quality Systems through management activities and systems registration instead of product certification are fast evolving in some parts of the world. Systems which encompass all levels - from workers to top management including participation by quality circles have also been practised in certain countries. Modulated Quality System is yet another new system (Fig 3) which has been evolved which incorporates the advantages of different quality assurance systems. In view of its potentially far-reaching implications, this system merits special attention by engineers who are intimately connected with quality issues and quality systems.

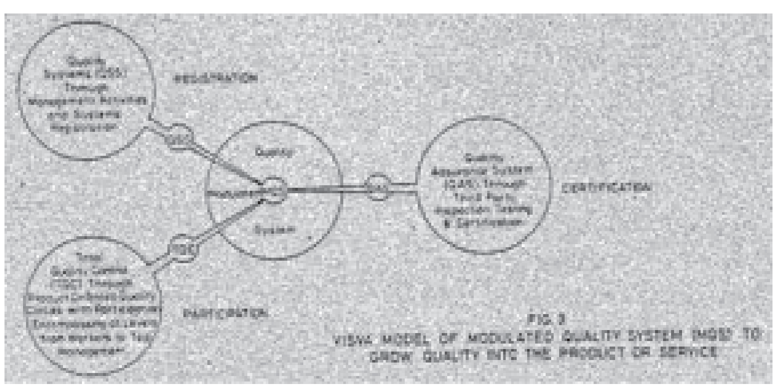


FIG 3
VISVA MODEL OF MODULATED QUALITY SYSTEM (MQS) TO GROW QUALITY INTO THE PRODUCT OR SERVICE

Research & Development — Much has been said about Research & Development in many fora. Here again, engineering oriented R&D has to be distinguished from science oriented R&D. Engineering oriented R&D, which involves models, unit operations, pilot plant and even prototypes, could mean a much higher ratio of capital to-revenue expenditure in an R&D establishment. Accordingly, much thought has to be given to the technology transfer chain involved between what might be called the normal bench scale work and its translation into industrial practice or field applications. In India, the total expenditure on all types of R&D is just 1 per cent of the total GNP as compared to 2.7 per cent in USA, 2.8 per cent in Japan, 2.6 per cent in Germany, 4.0 per cent in USSR, etc. Therefore, whilst on the one hand, investment on engineering R&D will have to be increased, special thought has to be given on how to deal with the innovative chain as related to engineering R&D; sometimes it might be possible to proceed straightaway to prototype without having to spend time or resources on models or pilot plant. Looking, at the remarkable success in our atomic energy, space and certain aspects of our defence area, R&D engineers could ponder on whether open-ended endeavours too could be transformed into closed loops emulating the former for better returns from R&D investments. In-house R&D in the industry needs strengthening and it may be advantageous sometimes to pool resources through co-operataives to get greater thrust. Engineers also have a special role in ensuring compatibility in the technology transfer chain between the face which absorbs, ie the transferee and the transferring face.

The National Design and Research Forum established by this Institution is making concerted efforts over the last several years to provide the required motivation and direction for our engineers engaged in research and design activities. The Extra High Voltage Forum is yet another specialized forum which has also been making useful contribution in this important area.

HUMAN RESOURCE DEVELOPMENT

Engineering Education — The first requirement in human resource development is education. In India, at present, there are some 700 polytechnics, engineering colleges, deemed universities and higher institutes of technology besides some 2,050 industrial training institutes. All these combined have an intake of over half a million students every year. Whilst these have been providing the basic human resources for our professional activities, the Institution of Engineers (India) has played its role by promoting engineering education through a system that can be considered a judicious combination of the traditional, open and distant learning systems. I do not intend to elaborate on this further as some of my predecessors have dealt with this subject at length and many of our senior engineers, who are educationists of high standing, are giving close attention to it.

Training — Continuing education, training and retraining are important in almost every walk of life. With the rapid rate of advance of science and technology and the consequent pace of development in engineering, it is all the more important for every engineer to be provided appropriate opportunities and means for keeping himself abreast of these developments. With a stock of over ten million engineers of different categories and levels, the task of training and retraining them in a systematic manner is a gigantic one. Whilst many engineering organizations have taken up training as an important element in human resource development activity, this Institution has given a thrust to this area by setting up a National Staff College of Engineering. This College along with various Centres of the Institution has been active in organizing regular training programmes for engineers. Training of trainers, application of modern techniques and tools for imparting training, constitution of optimal faculty groups, on the job training etc will receive closer attention as we progress.

PLANNING AND MANAGEMENT IN ENGINEERING

Whilst much of what is required to be done in planning and management by engineers is common with others in the society, the role of engineers is crucial because the engineer is responsible for expending a major part of the resources for converting them into goods and services.

Decentralized Centralization in Planning — The large number of diverse parameters that an engineer faces in any given situation and the fact that many of them have to be considered simultaneously, bring out at once that an engineer cannot adopt a dogmatic approach that planning should be from the top downwards or from the bottom upwards. Indeed, for an engineer it entails one exercise from the grassroots (micro level) upwards, and another from the macro level downwards; thereafter the two have to be combined into a balanced whole through an iterative process. And by his training, the engineer is most eminently suited to carry out these iterative exercises. In the matter of planning and implementing organizational systems, it is now clear that in most engineering enterprises centralized policy making with decentralized administration gives the best results.

Industrial Development — Whilst the medium and large scale industries in India contribute about 61 per cent of the production in the industrial sector, the small scale sector accounts for 38 per cent and the balance is accounted for by the rest of the industries including Khadi and Village and Cottage, Handloom and Handicraft industries. India's progress in the medium and large scale sectors of the industries in the last four decades is praise-worthy whilst her performance in small scale sector is phenomenal and is a shining example for many countries of the world; with over 1.5 million units employing some 11 million workers, the small scale sector today produces goods valued at nearly Rs 72500 crores, out of which nearly Rs 4500 crores worth is exported every year. Unlike in the old days, small scale industries today can be made to take the fullest advantage of science and technology — thanks to advances in the area of micro-processors,electronics, instrumentation, and communications which now can be utilized in many a small scale unit at affordable costs. In view of the socio-economic considerations involved in such an approach to industrial development, the engineer's responsibility in finding appropriate answers in such a heterogeneous situation becomes all the greater.

Management of Human Resources — Engineers are often referred to as people who deal with the five M's, ie, Management of Men, Materials, Machinery and Money. Of these, the most important and complex one is Management of Men. No matter whether they received formal training in the management of human resources or not, engineers have demonstrated that managing the men with whom they have to work is an important component of their professional responsibility. The principles of management of human resources, for an engineer, have much in common with those for other sections of the society. But here again in view of the nature of their work and the fact that they are essentially men who deliver the goods and services a community needs and not just files or documents as in some cases, the engineers' role in human resource management becomes more crucial in preserving and improving the quality of life in society. Therefore the fabric on which he bases his management has to be absolutely sound.

This base fabric has to be essentially Indian in character, because neither the individualist and economic mode of organization nor the collectivist and communist mode, which are practised in many industrialised countries, would be appropriate. The technical and economic successes of countries like Japan have amply brought out that modern science and technology can be exploited better if human resource management is not alienated from the cultural roots. Whilst we should draw upon all the advantages of the modern principles of management science, these have to be applied on the Indian base fabric for which our cultural roots give plenty of guidance. A widely accepted authority in this realm is a set of scriptures collectively known as the Darsanas which are exemplified through the six well-known schools of Indian philosophy — Vaisesika, Nyaya, Sankhya, Yoga, Mimamsa and Vedanta. Just to illustrate, one of the most important contributions of Darsanas is in the area of values. There are values attached to the different stages of the life-cycle such as Brahmacharya, Grihasta, Vanaprastha and Sanyasa — the 'student', the 'householder', the 'disengagement' and the 'renunciation' stages respectively. These very values can also be adopted in models for organizations where the top management can be made to realize that they move from one stage to the other. There are many engineers who have, by their own conduct amply demonstrated the application of such values in practical life. If these experiences are pooled, they can form an important contribution of our profession towards the progress of human resource management as a whole.

HUMANISM AND ETHICS

We appreciate that the profession we have come to occupy, either by choice or by circumstances, is a noble one because we have the privilege of belonging to a class of people who have been trained only to look at the progress of the society and identify our own interests with that progress. So much so, I believe it is possible for us to reach the loftiest goals that any human can aspire for, provided we are true to our profession based on ethical norms which are themselves based on humanism — self — imposed discipline, simple living, service to others as main aim, developing professional competence, ability to contribute in the most adverse situations, unattached action, internal and external integrity, quest for perfection, adaptability to changes combined with sympathetic understanding, and freedom from fear. I have elaborated on these issues in the Eleventh Nidhu Bhushan Lecture delivered in April 1977. Some of these values are also enshrined in the Code of Ethics of IEI, which we should all recapitulate again and again and practise.

It may be recalled that till a few decades ago, whenever the ills faced in the society were brought to the fore , the first and the foremost blame used to be passed on to the engineer. This was because the engineer dealt with men, machinery, materials and money and their integrated management. Over the years, engineers have demonstrated that they possess at least as much virtues as other performers in the society — perhaps often more because of the nature of their responsibilities and the type of their training. In recent years we have been seeing all over the world that it is some of the other performers in the society, rather than engineers, getting exposed for lack of sound ethical norms. Whilst the entire engineering fraternity — young and old, can be truly proudof having brought about this change in the outlook of our society on this matter, there is no room for complacence. We shall have to do our utmost to stick to the good norms of humanism and ethical principles. We not only should cherish and practise these ourselves but also should inculcate this spirit of goodness in the younger generations in particular and in the members of the society with whom we interact in our life, in general.

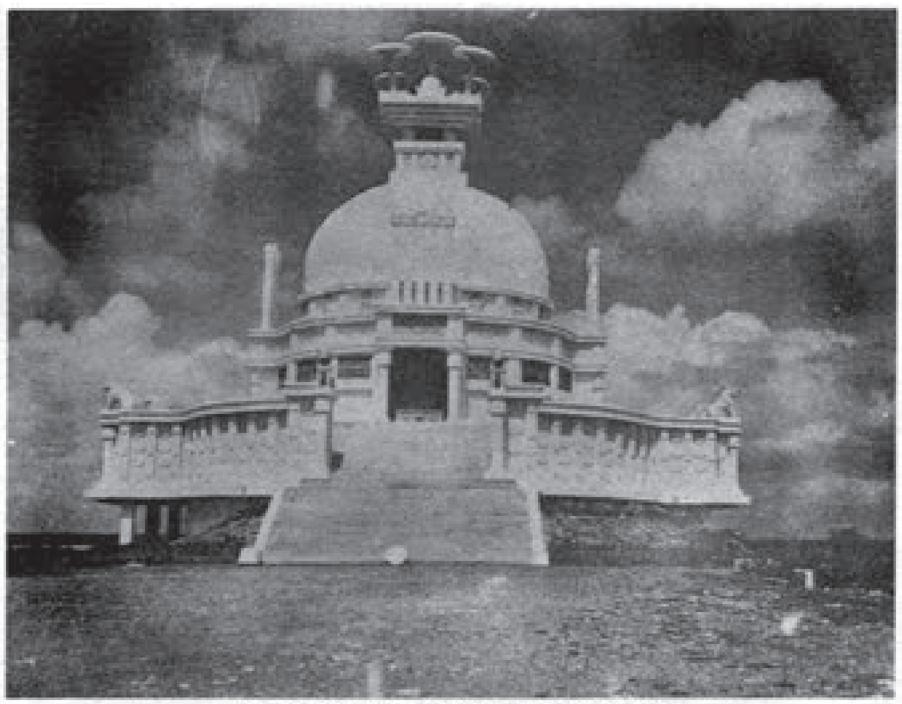
FINALE

The Institution of Engineers (India) has in recent years grown tremendously in several directions. It has become the biggest professional institution in the world with a total membership of nearly 4 lakhs. With as many as 80 Centres covering State and Local Centres, 5 Overseas Chapters, 15 Divisions covering various disciplines of activities, 41 Technicians Chapters, 192 Engineering College Students Chapters and 139 Polytechnic Students Chapters, this Institution today is a truly multi-disciplined, multilevel, mass-based professional body conceived and operated as a democratic organization. It has all the advantages of a democratic set-up and at the same time also faces the problems associated with running a good democratic set-up. This being so, the management issues in the Institution cannot be dealt with in the same way as in any other organization though certain principles and systems of management prevalent in others can be beneficially drawn upon.

The Institution of Engineers (India) has been growing and it will continue to do so a great deal further. It will grow in every dimension — in its professional and technical activities, in its disciplines of activities, in its international interactions, in its membership, and in the number of regional centres and in the number of overseas chapters.

Our global objective is that the society in which we live must be happy that the Institution of Engineers (India) is contributing its share fully in improving the quality of life in the society. To achieve this, all categories of members of our Institution must feel satisfied and happy that they are, on the one hand, provided opportunities to make their contribution towards this objective and, on the other, they are themselves continuously benefited professionally by the activities of the Institution; the engineering community as a whole must feel happy that their interests are well looked after by our Institution in harmony with our socio-economic environment; and those responsible for the management of the country and that of the multitude of engineering activities should feel satisfied that the national responsibility is being well discharged by the Institution. I am confident that with the assistance, cooperation and guidance of the members of the National Council who represent the engineering community in the country and of each one of you we will achieve the goals in larger and larger measure as we move on.

I wish you and all the members of your family a Very Happy New Year 1990.



Vishwashanti Stupa, Dhaulagiri hill

"न त्वहं कामये राज्यम्,
न स्वर्गं न पुनर्भवम्।
कामये दुःखतप्तानाम्,
प्राणीनाम् अर्तिनाशनम्।।"

Dr H C Visvesvaraya — a Brief Profile

Dr Hosagrahar Chandrasekharaya VISVESVARAYA, a distinguished Engineer of international repute, has been unanimously elected President of the Institution of Engineers (India) for the Session 1990-91. He will be installed in this honoured position on 31 December 1989 at the Fourth Indian Engineering Congress in Bhubaneswar.

Born on 11 October 1928, Dr Visvesvaraya is a Gold Medalist, First Class and First Rank in BE in Civil Engineering from the University of Mysore 1950 and Ph D in Engineering from London University at the Imperial College of Science and Technology 1956.

Presently Chairman of the National Council for Cement and Building Materials, having been earlier its chief executive for over two decades — as founder Director of its predecessor Cement Research Institute of India and then as Director General, Dr Visvesvaraya's present responsibilities, amongst many others, include Chairman Productivity Board for Cement: Industry, Govt of India, Chairman Civil Engineering Division Council of the Bureau of Indian Standards, Chairman of the Indian side of the Joint Indo-Soviet Working Group on Building Materials, Project Director of UNDP/UNIDO Project relating to Productivity Enhancement in Cement Industry.

The remarkable progress achieved in the last three decades in the field of building materials and construction industries which have accounted for over 40 per cent of the national outlay in the successive national Plans, have had a significant impact on the overall national development; Dr Visvesvaraya is responsible for a good measure of the success in these industries, the impact of his valuable contributions and pioneering developments being clearly felt all over. Building materials and construction being as old as civilization, Dr Visvesvaraya has demonstrated that for any meaningful advancement in these fields, the tradition and experience of the past have to be well blended with the. scientific and technological advances of modern times fully considering the economic and social implications.

For the last four decades, Dr Visvesvaraya has ceaselessly worked towards upgrading the cement, building materials and construction industries in the country. The National Council for Cement and Building Materials (NCB) which Dr Visvesvaraya conceptualized, planned, designed and established, has come to be acknowledged today as one of the foremost in the field — functioning through its eight Centres viz, Cement Research Institute; Construction Development Institute; Centre for Consumer Protection; Centre for Standardization, Calibration, Testing and Quality Control; Centre for Productivity Enhancement; Centre for Environmental Improvement; Centre for Industrial Information Services; and Centre for Continuing Education and Human Resources Development - of which every Indian can be proud of. For his outstanding contributions to the cause of promoting efficiency and productivity in cement industry through research and development, Dr. Visvesvaraya was awarded the Indian Merchants Chamber Award as far back as 1972.

Dr Visvesvaraya not only pioneered in setting up such institutions of excellence but also ensured that the work therein resulted in designs, technical facilities, operations and services, leading to Productivity Enhancement, Energy Conservation, Environmental Improvement, Quality Improvement, Better Safety, and Cost Reduction. He has also guided more than 75 patents of industrial importance. Dr Visvesvaraya was honoured with the National Design Award for the year 1988 in recognition of his contributions in this area.

NCB has integrated research, technology development and technology transfer, education and industrial services and he, as its leader all through, has exemplified how an organization can become a strong and important link in the industrial developmental process of a nation. The Matrix Method of Technology Development Management by Objectives evolved by Dr Visvesvaraya and adopted and implemented in NCB is today accepted as an ideal model for management of technology support institutions.

The deep devotion and commitment of Dr Visvesvaraya is reflected from the fact that even though he was appointed to the coveted position of Vice Chancellor of the University of Roorkee in 1982 and has been from time to time offered other top positions of national importance, he has preferred to continue to dedicate himself to the organizations he has so assiduously designed, built and guided since their inception and to the industrial developmental cause. .

Apart from his association with several international fora he has been UN Consultant on ten *occasions. To mention a few, he was Chairman of the UN Expert Group Meeting relating to Planning and Designing of Centres for Industrial Research, Design and Development, Innsbruck; Chairman of the Expert Group on Appropriate Technology under the auspices of the UNOST and UNIDO, Vienna; Chairman Expert Group Meeting on Industrial and Technological Information of Industrial Development Decade for Africa and UNIDO, Vienna; and Chairman Inter-regional Expert Group Meeting on Building Materials Industry under the auspices of UNIDO AND UNCHS (Habitat), Nairobi. Dr Visvesvaraya was the Leader of an international team of 21 experts for executing a UNDP/UNIDO Project in Syria from 1979 to 1982 and since April 1985 he has been directing a UNDP/UNIDO Project in India under which already 23 experts have completed their missions, a sophisticated process _ control simulator system designed and executed, and a mobile energy monitoring system commissioned. The contributions of Dr Visvesvaraya through his association with national fora are very many; he has been Chairman of more than fifty fora, including the High Level Committee appointed by the Govt of India for a comprehensive review of the working of the Cement Corporation of India; and has lead Indian Delegations to many countries on different occasions.*

Dr Visvesvaraya is also an outstanding national and international figure in Standardization and Quality Control. He has been a Fellow of the erstwhile Indian Standards Institution and now closely associated with the Bureau of Indian Standards, its Executive Committee, Standards Advisory Committee etc. He was conferred the prestigious Lal C Verman Award for his work in this field which has brought in not only several hundreds of standards into practice all over the country but also earned a recognition for the new concepts and for breaking new grounds in standardization.

Dr Visvesvaraya has made significant contributions in almost every facet of activity of the Institution of Engineers (India) during his close and active association with many organs of the Institution over the long number of years, specially as Chairman of Civil Engineering Division Board, Chairman of the Apex Monitoring Committee, and Member of the National Council for over 15 years; in the Delhi State Centre, as Jt Hony Secretary for six years, as Hony Secretary for four years and as Chairman for two years during 1969-71. Dr Visvesvaraya is in fact the founder Chairman of the Committee for Advancement of Technology and Engineering.

Dr Visvesvaraya was the Convenor of the 7th Commonwealth Engineering Conference held in India in 1968 — the first international conference of this type hosted by IEI, the remarkable success of which laid the foundation for many international events to follow. Dr Visvesvaraya represented IEI on the Committee of Engineering Information of the World Federation of Engineering Organizations (WFEO), and was the Chairman of its International Working Group on Engineering Information Services during the years 1971 to 1975.

An eminent personality in his profession, with profound knowledge and singular dedication to the cause of qualitative advancement of the engineering fraternity, Dr Visvesvaraya brings with him a new vigour and dynamism to the Institution. It is no wonder the engineering profession fervently looks forward to the leadership, guidance and support from Dr Visvesvaraya for its continuing efforts towards contributing in greater measure to the welfare of the engineering profession in particular and the nation at large. In announcing the unanimous election of Dr Visvesvaraya as its President, the Institution takes great pride.

Shri P J Mehta
President 1991-92

Presidential Address

AT THE ONSET

It is with pleasure and humility that I stand here elected unanimously to the highest office of the President of this great Institution. I am, indeed, grateful to my colleagues on the National Council for bestowing such a great honour on me. I hope and pray, on this momentous occasion, to be able to provide a high level of service, through realization of the aims and objectives of the Institution, with the help, co-operation and guidance of my fellow members, friends and the galaxy of Past-Presidents. I am well aware of the tremendous responsibilities of this high office in the context of the Institution's dynamic spread and involvement in advancement at the national level as well as its international activities. All the same, I am sure that the goodwill, cooperation, enthusiastic support and enlightened guidance of the Past-Presidents, Council Members and fellow members will help me meeting the challenge of elevating the profession and the image of the Institution.

I feel duty bound, on this occasion, to convey on behalf of all of you and on my own behalf, our sincere thanks and regards to the retiring President, Dr H C Visvesvaraya, a personality commanding such excellence of head and heart. Dr Visvesvaraya was responsible to raise the Institution to a loftier horizon both nationally and internationally. I would like to reassure him that I shall, with pleasure, share his precious thoughts and strive to the utmost to maintain the high standards he has set.

Today, we are, indeed, very fortunate to have amidst us our respected Chief Guest who has honoured us with his presence to bless and guide us. We are immensely grateful to you, Sir, for having given us this moment of exhilarating joy by sparing your precious and pressing time for our sake. Your esteemed presence will provide us with the spirit and enthusiasm to contribute our mite for the betterment of the nation in whatever humble ways we can. I also take this opportunity to extend a cordial welcome to our honoured guests from abroad who, despite their busy schedule of engineering practice, have responded to our invitation to attend this Congress and readily agreed to share knowledge and experience with their Indian counterparts. I hope your stay will be fruitful and enjoyable.

THE INSTITUTION OF ENGINEERS (INDIA)

It would not be out of place here if I give in brief the Institution's aims, objectives and activities for the benefit of those who are attending this Congress, particularly new members and non-members. It may be clarified here that the Institution of Engineers (India) is not an union of engineers engaged in fighting for the rights of engineers working in government, semi-government, public or private sector organizations.

The Institution

— came into existence in 1920 and was granted the Royal Charter in 1935. It has an avowed objective of promoting and advancing the art, science and practice of engineering in India.

— is today the largest professional society of engineers in India, having a membership of over 400000 personnel of various disciplines, playing critically important roles in building up the qualitative and quantitative strength of professional manpower, through its 85 Centres spread throughout India and five Chapters abroad.

— has under its umbrella 15 Divisions, each looking after activities of a particular engineering discipline. Each Division, besides other technical activities, holds its National Convention every year to disseminate engineering advances in that discipline and to facilitate wider interaction amongst its members.

— provides opportunity to those who aspire to pursue a career in engineering but do not have means to attend degree courses at higher institutions and universities or are unable to get admission, by conducting examinations in two parts biannually at many centres in the country. The aspirants can pursue their studies independently at home even while working. The passing of the Institution's examination is recognized by governments, public service commissions and public and private sector organizations as equivalent to a degree in engineering. Some universities have also recognized it for admission to post-graduate level studies. Thus, the Institution is effectively functioning as an open technical university in the country.

— sets standards for engineering qualifications and training schemes and maintains active collaboration with educational planning and re-orientation programmes of the Central and State Governments.

— has established an Engineering Staff College at Hyderabad (Andhra Pradesh) to act as a nodal centre for developing continuing education courses through profession-oriented programmes.

— has established specialized inter-disciplinary forums each concentrating on a particular field such as the National Design and Research Forum to encourage research activities; the Rural Development Forum for identifying the needs and solutions to rural problems; and the Water Management Forum for encouraging the study of conservation and equitable distribution of scarce water resources. One more forum for environmental protection is in the offing.

— observes September 15 of each year as 'Engineer's Day' in memory of the country's great Engineer-Stateman, Dr Sir M Visvesvaraya. On this day, a common theme of engineering having nationwide interest is chosen and discussed at all the Centres of the Institution and recommendations evolved are communicated to governments, industry and other sectors for their benefit.

— is the National Committee or Member of several international bodies and has bilateral technical cooperation agreements with 13 professional societies abroad and some more are in the offing.

— actively participates in International Conferences abroad and with a view to providing facilities for larger participation of Indian engineers and close interaction with foreign experts, regularly holds International Conferences in India. In the past four such World Congress on Energy, Mining, Environment and Prestressed Concrete have been successfully organized in India. One more World Congress on 'Natural Hazard Reduction' is planned to be held early next year in New Delhi and also a series of continuing international programmes such as India-Canada, India-China joint programmes.

— organizes once a year the Indian Engineering Congress in different parts of India which, apart from facilitating members and nonmembers of all disciplines to interact with each other, provides opportunity to participate in National Seminar and listen to memorial lectures of high philosophical and technical content delivered by experts. Eminent engineering personalities are also honoured and glimpses of their life and achievements are presented to the participants.

— has plans for establishing an Institute of Distant Learning, as well as a network of open learning centres at different places all over the country.

ENGINEERING COMMITMENTS

If we look at the developments that have taken place since Independence, the achievements of Indian engineers are truly commendable and noteworthy. Engineering profession has contributed admirably for the betterment of the masses. Much has, indeed, been done. Yet much more is required to be done. A look at the present state of affairs and future scenario brings home the realities of many spheres needing the urgent attention of engineers. We have yet to satisfy many needs both quantitatively and qualitatively.

BASIC NEEDS

The first and priority commitment of engineers shall be to help devise ways and means of providing the basic necessities of human existence — that of food, clothing, shelter and employment.

A close look at the progress made in India in the field of agriculture as well as cloth production reveals that the challenges of food and clothing for the masses would be within our grasp. Improved agricultural practices, increased irrigated acreage and other efforts have not only made the country self-sufficient in grains production but also have helped in building up a reasonable buffer stock. More or less same situation prevail in cloth production sector. However, sustained efforts would be needed to keep up the tempo of increasing production in both sectors to cater to the needs of increasing population and for possible exports.

The real challenge that we face is in the field of providing shelter to the millions in India. Already a staggering shortage of over 40 million units. I, prevail today. By the turn of the century, there would be a considerable increase. Against this shortage, the yearly realization is hardly 2.5 million units. This is perhaps housing has not received the treatment it deserved at the hands of the planners and decision makers.

There is, therefore, an urgent need to frame innovative policies and fiscal incentives to encourage greater flow of funds for investment in land development and housing by the private sector. The housing policy should aim at raising the real investment in housing by over 35% per annum in order to realize the goal of providing shelter to almost everyone by the turn of the century or soon thereafter. The challenge before the engineers is not only of mobilising more resources but also of increasing the speed of building housing units by industrializing housing construction and/or by providing necessary inputs through a widely distributed effective system or through any other model.

The need for providing gainful employment to the unemployed/underemployed class of people in the working age group is even more challenging. One of the viable ways in this direction on a sustained basis is to make sure that growth and developmental activities are widely distributed across all regions and sections of the population and are of a kind that can absorb the increases in the labour force and the backlog. There are many sectors or sub-sectors like roads, minor irrigation, housing, small scale industries and cottage industries in which increased investments can record maximum employment of labour. To the extent and till such time that employment generated through normal development processes does not adequately meet the requirements of those seeking work, a special programme of guaranteed work to the unemployed would be necessary. On the industrial front, engineers will have to playa significant role through innovative plant design and processes which while maintaining optimum production level are labour intensive.

DEVELOPMENTAL FALLOUTS

Having examined the problems of basic needs, the engineers' second commitment shall be to help in correcting the problems arising out of developmental efforts and endeavours of the last four decades. These can be broadly categorized as imbalances in development between urban and rural areas, resultant population migration from rural areas, which in turn is creating chaos in urban conglomerates, environmental degradation and ecological imbalances, indiscriminate and wasteful use of water, water pollution and impending water crisis and the need for water management.

IMBALANCE

Developmental efforts of the last four decades have, unfortunately, resulted in intensive growth in and around urban centres infusing a sense of deprivation in the minds of the rural masses which in turn has generated migration from rural areas. Our cities are unprepared and incapable of absorbing unchecked inflow of people creating innumerous problems in urban centres.

The first task, therefore, should be to spread the developmental network wide enough to encompass rural areas by providing necessary infrastructure. Government and planners have realized this urgent need and have carefully devised ways to allocate 50% of the resources to development of the rural sector in the Eighth Plan.

RURAL DEVELOPMENT

The complexity of rural development poses a challenge to the engineering profession in responding to the needs of the rural people. The task of rural development in this country has assumed special importance both to meet the needs of the rural people as well as to retard the process of urbanization.

A variety of agencies, both governmental and voluntary, have been functioning in rural areas with the objective of improving the quality of life of rural masses. However, those programmes and projects do not seem to have made any marked impact on the lot of the rural people. It is therefore necessary that more comprehensive and integrated developmental strategies are evolved to overcome the shortfalls and to generate a climate of enthusiasm and participation in the rural people.

Among the various steps directed towards rural development, it is suggested that retaining the talented rural manpower in rural areas by devising suitable economic activity, which is both gainful and satisfying, would prove very beneficial. Simultaneously preparing the rural masses, comprising 70% of the total population, to absorb the principles of engineering and technology in the form they can understand is also necessary. The National Council of the Institution, recognizing this need, has already formed the Rural Development Forum which is spearheading the engineers special commitment to the rural sector by promoting and developing ideas of rural 'Rural Technovation'.

ENVIRONMENT

One consequence of pursuing developing and adopting technologies without coherent framework of social objectives has been large scale environmental degradation. Deforestation, desertification, pollution of the atmosphere and of rivers and streams, fast depletion of watertables and destruction of top soil have all affected the very survival of the people. A great deal of public consciousness and debate has been generated on these issues. Improvements in the standard and quality of life of the people have to be based on sustenance of life support systems through conservation and regeneration of the natural resource base.

There should be more rigorous scrutiny of the environmental impact of every developmental scheme and only ecologically sustainable ones should be made acceptable. It is not that the process of development and maintenance of satisfactory environmental standards are incompatible with each other but what is important is a balance between the two by striking the right trade-off among different interacting forces. In recent times, rapid growth of population together with urbanization and industrialization have tended to tilt the balance, resulting in marked degradation of the environment.

The society's expectations from its engineers in this regard will be two fold. The first being to combat the pollution menace through screening the existing polluting industries and suggesting such measures which, while arresting pollution, do not result in a situation detrimental to the very existence of the units. A country like India, where the capital-output ratio is far from satisfactory, can ill-afford to do anything that results in making the existing industrial units unviable. The second being to search new technologies or modify the existing ones to ensure that while sustaining the industrial or other developmental growth, they do not endanger the safety and well being of the people by polluting the environment.

WATER MANAGEMENT

Human beings all over the world have a misconception that there is abundant availability of water and as such the same can be used indiscriminately and wastefully. This conception is proving to be incorrect as this precious resource is getting scarcer the world over. In India, the situation is no better. Unchecked population growth and rapid development have strained our water supply systems. The over pumping of underground acquifers and relentless cutting of trees, which trap and store water, have upset the hydrological balance turning large areas into floods and drought prone. At many places, the available water is sometimes contaminated by sewage and industrial waste, exposing those who drink it to diseases. There are thousands of villages without any local water supply forcing people to fetch it from long distances. In cities where the shortage is very acute, hospitals, hostels and even residents obtain water from private suppliers at a price. One can find an alternative source of energy to meet the oil crisis but one cannot replace water.

As it is not possible to increase the availability of water, the only alternatives are to educate people to use water economically, arrest waste, devise means to preserve the source and protect storage. Engineers will have to playa critically important role in the area of water management, now and in the future. Recognizing the dire need of efficient water management practices, the Institution. has already started an inter-disciplinary Water Management Forum with the objective of devising ways and means to conserve water and ensure equitable and unwasteful use. I am confident that the engineers involved in the area of water management will visualize the crisis developing fast and use their ingenuity to save the situation before it is too late.

CURRENT CRISES

After giving priority engineering commitments towards satisfying the basic needs and correcting imbalances in development, engineers' attention should be focussed towards crisis areas needing urgent efforts. The recent oil crisis, energy gap and prevalent unemployment and under-employment of engineers fall in this category.

Oil Crunch

The recent gulf crisis has forced the government to economize consumption of petroleum products, enforcing cuts in the normal supply. While appreciating government's attempt in economizing consumption to save precious foreign exchange by way of cut in the supply of oil, it would not prove to be the sole panacea. Already normal transport channels and other users are feeling the pinch of it. Long queues of trucks and other consumers are common sight at oil outlets. Not only precious man and machine hours are lost waiting at petrol stations but also the tendency of hoarding has begun. Reportedly even black marketing has started.

Mobility is an index of progress. Progress achieved by developed countries owe it to a larger extent to their uninterrupted and free flow of traffic. Cut in oil supply would impair mobility which in turn will retard progress, even arrest it. Means of achieving economy in oil consumption should rather be the removal of bottlenecks in the flow of traffic which, while maintaining mobility, can easily achieve 10%-15% economy in fuel.

To this end, short and long term strategies can be adopted. Safe, smooth and orderly traffic flow on our city streets and highways shall be achieved by resorting to measures like signallized intersections, channelization, pavement marking, seggregating mixed traffic, grade-separated junctions, exclusive lanes for turning, improving pavement conditions, widening carriageways to increase capacity and providing expressways in high density traffic corridors. The return on investments on these short and long term measures would not only be attractive in terms of lowering transport costs but also generate considerable economy in fuel consumption. An effective programme similar to the one implemented in the USA, namely, TOPICS, that is, 'Traffic Operation Plan for Improving the Capacity and Safety', needs to be undertaken on a priority basis for congested, unsafe and chaotic traffic situations prevalent on most of our streets and highways.

My long association with the apex body of highway engineers, namely, the Indian Roads Congress and the Ministry of Surface Transport, has convinced me that they do share this concern and are doing utmost to improve the situation to the extent possible within financial constraints. The successful experiments in several countries in involving private investments in the highway sector should be tried in our country also to meet the ever increasing gap between demand and availability of financial resources. Simultaneously engineers will have not only to introduce technological innovations to produce fuel efficient plants and machinery but also to see that the existing plants and machinery in our industries and elsewhere are suitably modified and/or tuned perfectly to run optimally with minimum fuel consumption.

Energy Gap

Energy consumption generally reflects the status of a country's economic growth. Though the per capita consumption of energy in India is much less compared to any developed country, even then the tap between the demand and supply of energy is widening year after year. Power cuts have become order of the day in almost all states including the capital region of Delhi. Added to this, our diminishing hydro-carbon resources, on which our thermal power plants depend, have been causing concern within the governmental circle as well as the industry.

There is, therefore, a need to have a national objective to move away from the dependance on non-renewable sources to renewable sources like solar, wind, water, ocean waves and bio-gas. Nuclear energy resource should also get high priority. We, as engineers, have to contribute our best to develop technologies that will generate cheap power from the renewable sources. Greater emphasis should be given on deriving energy from the sun, water and bio-mass, all of which are abundant in our country.

Simultaneously, measures to ensure conservation and efficient use of energy have to be taken on war-footing to meet the needs of the growing economy and population adequately. Massive campaigns to make everyone conscious of the energy crisis have to be taken through the electronic media and the educational system.

Development of energy efficient equipment and systems need to be encouraged through incentives and regulatory measures. The management of demand should be effected through a system of administered pricing, energy audits, effective monitoring mechanisms and through setting up of an integrated energy management cell at the apex level to plan, implement and monitor the programmes.

Engineers Unemployment

We are successful in creating a vast technical manpower base which at present stands third highest in the world, next only to the USA and the USSR. However, we are unable to utilize them optimally. Unemployment and under-employment prevail in the engineering profession and are increasing year after year. The plight of diploma holders is even pitiable. This situation results in frustration amongst engineers and their relatives. We perhaps have landed in such an unhappy situation because of a belief amongst engineering aspirants that the engineering degree/diploma is a sure path to prompt and rewarding employment. This belief needs to be removed and self-employment task performing culture needs to be cultivated. The fault does not appear to be in our training programmes, syllabi or technical educational institutions. Our institutions have and are producing brilliant engineers who have made their mark in the national as well as the international arena. Our engineers who have migrated abroad have proved equal, if not better, to their counterparts anywhere in the world. What is needed is change in orientation to imbibe a spirit of self-employment and to make them able to shoulder the responsibilities of administration, management, fiscal dealings and entrepreneurship over and above technical expertise. The Institution of Engineers (India) has in its fold brilliant academicians of repute and stature. I call upon them to give serious thought and evolve a system capable of meeting the challenge. Change in concept from traditional discipline oriented courses to profession or job oriented courses may be the answer.

OTHER SECTORS

The need for improving the living standard and the quality of life of our people as well as to help march the nation from developing to developed status should be foremost in the minds of engineers. In this regard, I will like to touch some important sectors which should attract the attention of engineers.

Industry

The policy of liberalization during the past few years or so has given a fillip to industry in regard to expansion of existing units and establishing new ones, resulting in rapid growth of the country's industrial output. However, the need for a greater degree of self regulation of industry and trade in respect of quality control and fair business practices have been felt more than ever to generate competitive confidence in buyers in domestic as well as foreign markets. The thrust of liberalization should also shift towards improving the technology and efficiency of the industry for reducing costs, increasing competitiveness and building the base for greater self-reliance.

We have been witnessing over the years, several instances where due to eventual loss in business our industrial undertakings are getting to the path of declaring themselves 'sick' units, thereby creating a deadlock in progress and forcing thousands into utter despair. The study of the growth and dynamic competitiveness demonstrated by a tiny country like Japan during the past few decades serves as a beacon-light to guide our industrial policies and the role of our industrial engineers. Our engineers and technologists associated with industries, therefore, need to develop short term and long term objectives and corresponding action plans to meet the challenges of competitive domestic and world markets.

Information Management

The problem which is facing modern society today is information explosion expanding day by day. The younger generation is posed with certain conflicts of interest and value systems because of its continuous exposure to this explosion. The wealth of nations which depended upon land, labour and capital has now come to depend upon information, knowledge and intelligence. This is not to say that traditional forms of wealth will be unimportant but a new form of power consisting of facts, skills, codified experience and large amount of easily obtainable and accessible data have assumed greater and greater importance in the modern world. The information process systems will be a central tool in almost all areas of social activity like economics, industry, science, engineering, administration, international relations and so on. The key to prosperity of Japan is its capability to generate, process and analyze the mass of information through well developed electronic gadgets and computers. Information management and processing is going to occupy more and more time and efforts of the engineers in coming years. Most modern communication systems for effective flow of information and control of operations, monitoring and quick decision-making is vital. This is one of our weak links which merits a big thrust. The role of the engineer here is that of a calalytic agent for change. The contribution of the fraternity of electronic engineers will become the major instrument in the nation's development, progress and prosperity.

Quality Culture

One aspect where our industrialists and engineers have to pay much greater attention is towards improving quality of our goods and services. It is possible for us to boost our exports, thereby earning higher foreign exchange, if adequate attention is paid to quality and acceptance standards.

The captive domestic market has perhaps led to complacency and lack of quality consciousness. For improvement in quality and selling products and services from an absolutely sellers' market to a buyers' market, industries must compete not only with each other but also on a global level. We have again before us the shining example of Japan's post-war industrial success which is attributable to one key factor quality at competitive costs.

The concept of 'Policing Quality' that is testing the product or material used in manufacture for its eventual acceptance or rejection, need to be replaced by a more progressive culture of 'fostering quality'. Quality through management activities and systems rather than product certification is now fast evolving. In view of the far-reaching implications of quality control and quality assurance it merits special attention of engineers who should aim at the culture of Zero Defect.

AT THE END

I have tried to touch some of the important issues before the nation and the expected role of engineers for the betterment of our masses. The need of the hour is total commitment to the cause of national development. The coming years are going to pose increasingly greater challenges and we will be called upon to playa significant role for the welfare of the society. It is the responsibility of one and all of us to team up and rise to the occasion to demonstrate our capacity and commitment of leading the society towards progress and prosperity. The Institution of Engineers provides the profession with a forum and a voice. We must use the Institution in assuming leadership role in various spheres of the nation's development and defence. The prestige and public recognition of our profession would be in proportion to the success we achieve.

The future is not one of ease or resting for engineers but of incessant striving so that we may fulfil the commitments we have made. The service to nation is the service to the millions who suffer. And so we have to labour and to work and work hard to give reality to our commitments. For doing so, we the engineers will have to become better managers, better managers for ourselves as well as for our clan. We will have to strengthen our ties of friendship, cooperation, professional and ethical links by taking active interest and participation in the activities sponsored by the Institution to earn due pride for our profession through competence and mastery over the jobs we are called upon to handle.

Before I conclude, I wish to express my grateful thanks to the honoured Chief Guest for gracing the occasion and inspiring us. I would like to express my sincere thanks to all the members present here for giving me a patient hearing.

On my part, I take this opportunity once again to assure you of my continuous service whenever and wherever you want.

Jai Hind!

Shri P J Mehta — A Brief Profile

Shri Pravinchandra Jaisuklal Mehta, Consultant in Highways, Bridges and Construction Management, and a most reputed personality in the engineering profession, has been unanimously elected President of the Institution of Engineers (India) for the session 1991-92. He will assume this high office at the Fifth Indian Engineering Congress to be held at Kanpur on December 16, 1990.

Shri Mehta (b August l3, 1927) attended the Birla Vishwakarma Muhavidyalaya, Vallubh Vidyanagar, and obtained his BE in Civil Engineering with Honours from the University of Bombay in 1951. He had his early training in soil stabilization at the R&B Research Laboratory, Karnal, and had also attended Senior Officers' Refresher Course at the Central Road Research Institute, New Delhi.

An expert in design, construction and maintenance of roads. bridges and buildings. Shri Mehta was responsible for expanding these vital infrastructural facilities throughout the State of Gujarat. He was promoted as Secretary in the Roads and Buildings Department of the Government of Gujarat in 1984 and during his tenure he showed his acumen as an outstanding engineering administrator and planner. He was instrumental in the efficient administration of the Department including policy decision, programme implementation, overall direction and guidance, planning, monitoring and physical as well as financial management of all buildings. highways and bridges, development and maintenance programmes in the State and also coordination with other departments and liasion with the Government of India.

His professional career started in the Public Works Department of the erstwhile State of Saurashtra in 1952. He subsequently rose to the position of Superintending Engineer in 1972, Deputy Chief Engineer in 1978 and Chief Engineer (Capital Project) and Joint Secretary in the Public Works Department in the same year. Subsequently he was assigned the office of Joint Secretary in the Buildings and Communication Department. These multifarious duties which he successfully carried on bear eloquent testimony towards his steadfast progress, dedicated service and magnificent achievements.

Shri Mehta has also been responsible for new construction and improvement including the geometry and riding quality, improvement of carriageway, widening and pavement strengthening of thousands of kilometres of roads in Gujarat.

A pioneer in the introduction of mechanization in bituminous pavement laying in Gujarat adopting hot mixing with sophisticated continuous process hot mix plants and paver finishers, he was also instrumental in adopting such innovative practices as computer application in RCC design, updating the schedule of rates. etc.

An outstanding engineer ever willing to launch creative approaches, Shri Mehta has initiated and formulated tech-economic studies and feasibility reports on the project for construction of India's first ever Express Highway between Ahmedabad and Vadodara and rendered invaluable support in completing this project. He was also closely associated with the design, construction, maintenance and restoration of a large number of major bridges in Gujarat — many with difficult foundations and superstructures varying from simple RCC to complicated prestressed concrete segmental construction.

The new Capital City project at Gandhinagar is yet another landmark in which he has left his imprints. This included construction of important administrative and Civic buildings — many highrise ones — city streets, water supply, underground drainage, area landscaping and beautification.

He is also closely associated with the Indian Roads Congress in which he is a Life Member and is a member of the Indian National Committee of the Federation Internationale de la Precontrainte (FIP).

Author of several technical reports and learned papers published in various technical journals, Shri Mehta has also widely travelled in India and abroad participating in national and international conferences.

Shri Mehta has made noteworthy contributions towards the progress of the Institution. A firm *believer in the potential benefits of an integrated professional organization, Shri Mehta, as member of the National Council of the Institution, Chairman of the Gujarat State Centre, Chairman of the Civil Engineering Division, Chairman of the Buildings Committee, and member of the Finance Committee, has contributed immensely to the realization of this goal. His wise counsel has always been sought in the various administrative and other issues in the management of the Institution. He is also member of the Board of Governors of the Water Management Forum of the Institution at Ahmedabad.*

The election of Shri Mehta as President of the Institution brings to us a charming personality, conscientious and dedicated leader whose wisdom, dynamism, administrative ability and deep concern for the well being of the Institution will raise the image of tile Institution to new peaks in fulfilling its objectives and the status of the engineering profession to greater heights.

Shri G P Lal

President 1992-93 & 1993-94

Presidential Address

(1992-93)

I am extremely grateful to the members of the National Council of the Institution of Engineers (India) and through them to the members of the our great organization for the honour they have bestowed on me by unanimously electing me as the President of the Institution of Engineers (India).

I am fully aware of the great responsibilities that go with high office. I will try my best to come up to the expectation of my fellow members. I feel confident that the guidance, cooperation and wholehearted support of the Past-Presidents, my colleagues in the Council and fellow members and various officers of the Institution will enable me to justify the confidence reposed in me.

I take this opportunity to convey my personal gratitude to the outgoing President, Shri P J Mehta, who, during his tenure of office, so ably guided the Institutional activities and uphold the dignity of the office.

I also pay my regards to my predecessors in the office for the excellent work done by them. Because of their foresightedness, sincerity and leadership, the Institution of Engineers (India) has enlarged both its membership and its activities. The last two decades have also seen the Institution's involvement in international activities and linkages. I feel greatly encouraged as I find among us today many of the past Presidents who spearheaded the Institution's development.

THE INSTITUTION

As mentioned in the Industrial Commission Report of 1916-18, the need to establish an Institution was felt from 1916. However, the Institution was founded on September 13, 1920, under Company's Act of 1913. Later it was granted the Royal Charter in 1935. This was the first Royal Charter given to a body with its origin and functions in India.

The object of the Institution as defined in the Royal Charter is to promote the general advancement of engineering' and engineering science and their applications in India and to facilitate dissemination and exchange of information and ideas on those subjects amongst the members attached to the Institution,

The membership of the Institution has now grown to about 400000 consisting of about 100000 Corporate Members and about 300000 non-corporate members.

There are 15 Divisions, each looking to the activities of a particular discipline of engineering, The Divisions hold two Paper Meetings and a national-level Convention each year to disseminate knowledge of advancement in engineering and technology. The Institution publishes technical Journals in all the disciplines and conducts technical lectures, continuing education courses, seminars and symposia. It provides opportunities for working technicians to upgrade their knowledge and qualifications and, consequently, professional status through its 87 Centres located along the length and breadth of the country. The Institution has also established forums, covering different areas of specialization for intensive activities of inter-disciplinary nature. These are: The National Design and Research Forum at Bangalore; Rural Development Forum at Calcutta; and Water Management Forum at Ahmedabad. With these Forums having been established, the Institution is in a position to establish a chain of subsidiary units attached to these for extensive activities. The Institution has also established an Engineering Staff College at Hyderabad for developing continuing education courses through profession-oriented programmes.

An annual discussion is organized at all the centres of the Institution on a common theme of engineering having nationwide interest, corresponding to September 15 — Engineers' Day — birthday of Bharat Ratna Dr M Visvesvaraya. The recommendations emerging from the discussions are sent to the Government and to the concerned organizations for follow-up action.

During the Annual Indian Engineering Congress, Memorial Lectures are organized and eminent engineering personalities are also honoured.

The Institution has representation on several national bodies and has bilateral technical cooperation agreements with oversea professional societies.

The Institution is the founder member of the World Power Conference established in 1924, and now known as World Energy Council (WEC), and is active member of World Mining Congress (WMC), World Federation of Engineering Organizations (WFEO), International Federation of Prestressed Concrete (FIP), Commonwealth Engineers' Council (CEC), International Institution of Production Research (CIRP), International Council of the Aeronautical Sciences (ICAS), International Federation of Automatic Control (IFAC) and again a founder member of Federation of Engineering Institutions of South & Central Asia (FEISCA). We were the host for the CIRP in 1975, the 12th Congress of WEC in 1983, the 12th Congress of WMC in 1984, the Second Congress of WCEE in 1985, and the 10th Congress of FIP in 1986.

A World Congress on 'National Hazard Reduction' is being organized by the Institution of Engineers (India) during January 10-14, 1992, in New Delhi.

The Institution has bilateral relations with 14 sister societies abroad — Hungary, USSR, USA, Germany, Bulgaria, China, Yugoslavia, Poland, Czechoslovakia, UK, Nepal, etc. The mutual benefits necessarily outflowing from these bilateral relations and collaborative international membership have been many, adding a new height to the country's technological image.

The Institution conducts examinations since 1928, passing of which is equivalent to graduation in engineering as recognized by all Governments, Public and Private Sectors and other organizations. This has become very popular and the number of students seeking examination has steadily increased from 103793 in 1986, and 122411 in 1989 to approximately 166000 in 1991. This way, this Institution may be considered as the premier open university for examinations in engineering.

To maintain compatibility with the requirement of profession in consonance with the global scenario of developing professional expertise, the Institution revises its syllabi from time to time.

The syllabi designed recently intend to provide training in the basic and common principles of design, production process and management of systems. Stress has also been given on Computer Science, Environment, Energy and other emerging subjects like Reliability Engineering, Terotechnology, Non-conventional Energy Production System, etc.

The students and technicians of the Institution are there throughout India, some abroad and many of them are in far flung areas with little guidance available, making it difficult to pass the examinations. They need regular guidance teaching and advice for preparing themselves for the examinations. Otherwise also there would be growing demand for non-formal and distance education as more and more people would aspire to acquire basic qualification and improve their vocational skill to face new challenges more confidently.

The National Policy on Education Programmes of Action (1986) has also referred that distance education 'augments opportunities for higher education, ensures access, is cost-effective and promotes flexibility and innovative system for education'.

The Institution of Engineers (India) is addressing itself to the establishment of a Distance Education Centre using appropriate technology and strategy to effectively provide the students with new vistas of learning opportunities in all localities and for every individual situated anywhere.

Friends, I would have liked to share with you many thoughts regarding the profession but the time being short, I propose to confine myself only to some thoughts on quality of life, the danger of the post-Industrial Society, the shape of technology as it is practised today, the dilemma it brings about and about quality consciousness.

ENVIRONMENT AND QUALITY OF LIFE

In our urge for development, the ecosystem is being seriously over-stressed leading to the degradation of the environment. Unless we keep the development activity within the carrying capacity of the supporting ecosystem, we shall be denying the future generation their ability to meet their own needs. The degradation of the environment has become a serious threat to existence and is a matter of global concern. We have to take great care of environmental protection and keep pollution within the recycling capacity in all developmental projects. While development is necessary for people to enjoy better life, action has to be analyzed keeping conservation at the required level. We have to commit ourselves for a sustainable living.

The World Conservation Union, United Nations Environmental Programme and World Wide Fund for Nature, in colloboration with other similar societies have suggested global alliance for meeting the challenge. They opine: the lower-income countries must be helped to develop sustainably and to protect their environments. Global and shared resources, especially the atmosphere, oceans and shared ecosystems, can be managed only on the basis of common purpose and resolve. The ethic of care applies at the international as well as the national and individual levels. No nation is self-sufficient. All stand to gain from worldwide sustain ability and all are threatened if we fail to attain it.

Appreciating that the problem of environment has to be handled at global level, we have to consider that the underdeveloped and the developing countries have yet to meet their urgent needs and they have to direct their limited resources towards their immediate concerns. Therefore, they need to be helped technologically and monetarily to trade off their increased cost on the projects with environmental concern. To take care of this, there is a need of a properly funded international institution. Global environment and development of the underdeveloped countries both have to be a global concern.

POST-INDUSTRIAL SOCIETY—THE DANGER IT PUSHES US TO

An irreversible change is continuously occurring in the world, at an ever accelerating rate but with extreme trouchs and crests, both within a country and on all its fronts with other Countries — geographical, political, economical, social, technological, educational, environmental and others. This has been referred to as the drift towards the post-industrial society by E L Trist.

At the close of this century, we find technology playing greater role in shaping our destiny though this has always been with us almost from the beginning of evolution of civilization. It is not some external force by which we are pushed around; in fact, society and technology are reflections of one another.

Technology offers different alternatives for performing any desired task. Man's increasing knowledge about nature and his economic interest in using that knowledge to lessen the man-hours of any work jointly create the series of alternatives. This means that for any task, there is no unique technology as there are many options or choices. Only it is that under a given situation, one of the options becomes the only most suitable. With a drifting situations, the choice or the option also shifts.

If we look at the root of this drifting situation, we see that it is due to the very nature of man himself, his expectations and his aspirations. This being at the root, the social requirement and hence the situation changes. In this context, technology means the use of knowledge of nature to serve the varying social requirements; the requirements are mainly economic, but at times they are political, religious, educational, defence, environmental, cultural and sometimes a complex combination of some or all of them.

Let us take an example. Imagine a team of civil engineers each of whom has a different prime criterion for designing a housing complex for middle-income group people. The first one is to design at a minimum cost of construction, another to maximize utility of space; one to allow sufficient natural air and light, one to ensure a building life of at least 100 years, one to bring novelty in building materials, one to design it in harmony with the surroundings, and so on. The varying prime criteria of these assignments must result in designs manifestly different from one other. This illustrates how, with given knowledge of nature, preference of man is embodied in design or selection of technology.

Selection or choice is the process by which man's social, especially economic, relations are imprinted upon technology. Dependent upon the variety in knowledge of nature, choices must be made by and come from man, not from nature. Technology thereby bears the characteristics of the given social relational system, especially the decision making process on production. That is, the means of production cannot be established without defining the criteria of decision making related to production, because the random selection of criteria or technology makes no sensible proposition.

We can thus infer that choice or selection and change or drift have a bi-directional governor/governed relationship. An important question can be raised at this point: Is this change under control? To quote Sir Geoffrey Vickers, 'The greater the degree of change, the greater the need for planning, otherwise precedents of the past would guide the future; but the greater the degree of uncertainty, the greater the liklihood that plans right today will be wrong tomorrow.'

TECHNOLOGY-PRACTICE AND THE TUNNEL VISION

'Technology' implies different conceptions at different levels and they have to be distinguished. It will be appropriate to appreciate technology as a human activity and as a part of life,. and to find out which aspects of technology are tied up with cultural values and which aspects are value-free. Technology is therefore not only the assembly of machines, techniques and precise knowledge and skills to perfrom a task, but involves the characteristic patterns of organization and imprecise values and ethics.

An orderly view of what technology-practice entails has been given by Arnold Pacey. Technology-practice has three aspects: (i) Technical, that provides the restricted meaning of technology; (ii) Organizational; and (iii) Cultural; these three together provide the general meaning of technology. The last two together reveal the human aspect of technology.

Now the technical aspect includes—knowledge, skill and technique; tool, machines, chemicals, liveware; resources, products and wastes. The organizational aspect includes economic and industrial activity, professional activity, users and consumers, trade unions. The cultural aspect includes goals, values and ethical codes, belief in progress, awareness and creativity.

As because some branches of technology deal with processes dependent on living organisms or 'liveware' as in brewing, biotechnology, agriculture, medicine, Pacey takes into consideration liveware as well as hardware and puts forward the definition:

'Technology-practice is the application of scientific and other knowledge to practical tasks by ordered systems that involve people and organizations, living things and machines.'

An example will illustrate the importance of integrated appreciation of technology-practice. During the decade of drought in 1960s, in India, drilling rigs were employed to exploit ground water at large depths. At the bore-hole wells, hand pumps were installed to the extend of 150000 by 1975 and, unfortunately, as high as 66% of them were found broken by that time. A certain percentage had operational life of only one month. A technical post-mortem revealed faults in the design of the pumps and in standards of manufacture. Even after repairs, pumps continued to serve wrong. Anatomical examination revealed that (a) the breakdowns were not exclusively engineering problems, (b) there were no administrative guidelines for servicing the pumps in a routine manner, and (c) neither was there any initiative from the people whom the pumps served to take personal responsibility for looking after them. A little attention to these factors in later period showed a considerable improvement in the performance of the pumps. We can realize that the above points are related to the technical, organizational and cultural aspects of what is now integratively called the technology-practice.

The roots of the problem with the above example can be traced in the engineer's way of thinking and the tunnel vision and many types of 'fixes' it leads to. Sometimes we weigh the technical aspects alone, though building the organization for maintenance is also a part of our responsibility. And there is an indication of a basic conflict of values between trained engineers and the relatively uneducated mass of the Indian villages.

Many professionals in technology are aware that the problems they tackle even only technically have social implications to different extents. In the presence of pressure groups they feel hesitant in taking even technically sound decisions.

The tunneling of vision, as referred to earlier, is best expressed in the saying of a medical practitioner that 'professionals are almost trained to ignore'. They learn to examine specialized aspects of problems with a concentrated attention that blinds them to other issues.

Many of the world's problems turn out to be problems of poverty, but normally the professionals are preoccupied with technical matters. Tunnel vision is one of the factors. Let us take the example of the grim energy crisis. Space technologists envisage an energy prospect favourable to building solar power devices on satellites and transmission to earth; nuclear scientists visualize an energy crisis for which nuclear fission, and ultimately fusion, is the only one answer; biotechnologists argue that their new techniques only hold promise; environmentalists consider that renewable resources are only to be tapped. Nevertheless, the tunneling behaviour of the specialists cannot be totally condemned at times. In the exploration of any knowledge yet uncovered, tunnel vision may provide determination and help hit the target within reasonable span of time. Once achieved, only then its social consequences ought to be judged, but then (that) the dilemma starts creeping in the mind of the technologists.

TECHNOLOGICAL DILEMMA AND HALF-WAY TECHNOLOGY

In the industrialized nations man is enslaved and addicted to technology. Technology provides material comforts and covers at the same time deeper and more important social, political and psychological shortcomings of the present day society. This view is gaining momentum in those countries and also the less industrialized countries which borrow or buy those technologies. The shortcomings of contemporary technology are generalized and misdeemed as evils of all technology — and this explains the rise of anti-technological schools of thought in industrial civilization.

To characterize contemporary technology, which invites problems in decision-dilemmas and is pollution producing. Robin Clarke places five rejoinders as follows:

(i) Price Response: Pollution is the price we pay for an advanced technology, and it is well worth the price because it is a means of escape from the poverty in which we live.

(ii) Fix-it Response: Let us have the technology to survive first and then adopt a further technology anit-dotal to pollution. This response is primarily scientific and technical, and sometimes technocratic.

(iii) Away-with-it Response: Radical or fundamental in nature, the argument is that either we pay a high premium for advanced technology or else we learn to live without technology at all, or with minimum of technology.

(iv) Alternative Response: It claims that many of the current technologies are intrinsically pollution-producing only a handful are not. New forms of technology which will radically replace the current ones can be devised to rescue us from deteriorating situations; the alternatives must not be technically fix solutions.

(v) Political Response: It suggests that pollution is an invention of capitalist elites and only a product and symptom of capitalist society-private or state.

The existence of many anti-society flaws in modern technology gave rise to the 'social responsibility' movement in science where scientists themselves were held responsible for the uses to which their work is put under the influence of different pressure groups. A similar argument also pinpoints the misuse of science and technology as well as their proper uses. What is to be inferred is that just as modern technology has made contemporary man feel more comfortable and secure against many hazards of the environment he lives in, so too has technology added lethal potentials of ennihilation to life.

Modern technology means centralization; pollution; capital misuse of natural resources; incompatibility with local cultures; dependence on specialists; and alienated workers; and all these aspects collectively entangle us who are the leaders of society from every walk of life in the technological dilemma.

In this background, let us now come to half-way technology. Lewis Thomas, a prominent medical researcher and biology-watcher, writes in a paper that technology is seen at its best in the use of anti-biotics, and in modern methods for immunization against diptheria and childhood virus diseases. These techniques, he suggests, are decisively effective and relatively inexpensive; they may appropriately be thought of as 'real high technology'. In contrast, organ transplantations and cancer treatment by surgery and irradiation are, quite paradoxically, highly sophisticated and profoundly primitive. Thomas has coined a very appropriate term 'half-way technology' for them. Here knowledge makes the sole difference. When a problem is understood, neat and cost-effective means of tackling it are found. Half-way technology, he argues, is the result of trying to handle problems which are only half understood. Devoted research is required to find better solutions.

Consider the problem of food shortages in many parts of the world. The technology of Green Revolution may be planned to increase food production without any clear idea why food consumption is low. Different organizations estimate different number of people to be under-nourished — from less than 100 millions to over 1000 millions. The figures are meaningless because there is confusion about what is being actually measured — hunger or poverty, malnutrition or under-nutrition. Chronic malnutrition is widespread, but it is not caused by any single physical factor like scarcity of food. Rather it is a problem of having multiple causes, many of which are closely linked to conditions of inequality of resources, of proverty, and of social discrimination.

Energy problem is a global problem. Let us consider electricity — its generation, transmission and distribution and associated problems in our country only. There is a large gap between demand and supply, and you experience scheduled and unscheduled power cuts, problems of low voltage, fluctuating voltage and frequency of supply, etc of the stations cannot generate to their full capacity, transmission and distribution losses are high, wasteful burning of electricity, unauthorized tappings from low-tension, at times even from high-tension lines, all reflect the culture of not only half-way technology, but half-way technology practice as well.

Consider the case of water supply in cities through underground pipe networks. There are many industries where water can be recycled before discharging it to waste. Leaking pipes and free-running water taps by the roadside contribute to loss of purified' and pumped water to the extent of 35%-40%. This gives rise to a man-made crisis. Enthusiasm for enlarging supplies without seeking causes of losses has been characterized as a 'supply-fix' mentality, though this attitude is rapidly changing.

An appropriate solution would be to bring coordination between expert and user interests by actively involving people in the areas of planning, designing and policy-making. Besides being confident about their profession, professionals should also possess the confidence of the society whom they serve.

PLANNED DEVELOPMENT

In the post-independence era, it was felt that the most effective steps for confidence building of the society would be uplift of their quality of life and living standards. Towards-this end, we had opted for planned development in the formative years of our country's advancement.

Our first exercise began with a strong emphasis on the strategy of industrialization. The industrial resolution of 1948 had committed the country to deliberate industrialization within the concept of mixed economy — spheres allocated to the private and public sectors. This concept, modified and developed at various points of time, still forms the basis of our economic system.

However, the resolution was never fully implemented. Several years after its adoption, planning administration and development of state enterprises fall short of the expansion visualized by Nehru and the Industry Policy Resolution. Today, it is realized that some gaps have crept in between the policies and their implementation. Industry needs to be integrated and the total industrial planning has to be more comprehensive to effectively put to use all available resources for the betterment of society. An integrated approach can only create permanent employment and prosperity to the society.

We are now at the threshold of Eighth Plan. There has been substantive development in various sectors through the successive Five-Year Plans. However, we still need more rapid overall development and diversification of economy and the need to strengthen the infrastructural base. For any sector, energy and transport form the basic infrastructure. I would very briefly highlight these two sectors only.

In the energy sector, even with an investment of Rs 77000 crores till the end of the Seventh Plan, the per capita consumption of electricity in the country is presently at a level of 250 units against 15000-20000 units in developed countries. The All-India anticipated power supply position by end of 1991-92 will leave over 17% peak shortage and over 8% energy shortage.

The Second National Power Plan brought out by the Central Electricity Authority (CEA) during 1987 assessed the power requirement beyond the Seventh Five-Year Plan. This was subsequently modified by the Working Group of the Planning Commission which assessed the requirement of fund for supporting proposed power plants during 1990-95 as Rs 128000 crores. With the resources available and projects already in progress and cleared, it is estimated that an addition of about 37000 MW only may be possible during the Eighth Five-Year Plan period (1992-97).

The present communication network comprises 1800000 km of roads, 61400 route-krn of railways, 10 major ports and 178 intermediate and minor ports, 14 major airports, 2570 km pipelines and limited inland water ways, coastal shipping and aerial ropeway with rail, and road catering to 95% of domestic passenger and freight movement. There has been a phenomenal increase in the freight and passenger carried by road and rail. In regard to freight carried by road, the increase has been from 6 billion track kilometres (BTK) in 1951 to 227 BTK in 1985 and projected to be 1004 BTK in 2001. Similarly, the number of passengers has increased from 23 billion passenger kilometres (BPK) in 1951 to 722 BPK in 1985 end it is expected to be 2152 BPK by 2001. The total number of registered vehicles has increased from 0.3 million in 1951 to 10.23 millions in 1986.

There has been significant improvements in the fields of energy and communication. However, we are still far behind the developed countries and our development has to be taken to an even higher level to support and sustain the desired economic growth.

QUALITY CONSCIOUSNESS

Our rate of achievement in the product quality and services has been substantial. But at the same time, users' expectation for quality performance has grown at a faster rate resulting in significant quality gaps. Present day buyers seek satisfaction in their purchase on the total value concept of quality consistent with economy, serviceability, safety and reliability. This changing scenario calls for quality management approaches underlying the necessity of control of quality in all aspects of our daily life. Quality management is much broader in its scope within the traditional definition involving quality control checks and associated statistical tools such as control charts, frequency distribution diagram, statistical quality control, etc. It is, therefore, imperative that the entire gamut of the strategic implication of total quality management on overall business performance is considered at all levels. Explicit and continued commitment of top management to support quality improvement programmes is critical for achieving excellence in this area. The strategic importance of total quality management becomes obvious when one takes into account such benefits of total quality programme as improvement in product designs and quality reduction of operation costs, improvement of employees' morale, removal of operating line bottlenecks, etc. It has been estimated that our country wastes around Rs 54000 million per year on account of rejection, rework and other consequential expenses in the manufacturing sector alone because of inadequate attention to quality which works to about 25% of our estimated annual domestic production.

Looking at the global level, we see that many countries are clustering into regional groups to meet the challenges of competition. International Standards Organization (ISO) has prescribed the quality standards ISO 9000, and EEC has already started making laws giving privileges to suppliers with ISO 9000 certification. Therefore, if India has to compete effectively in the world market, we have to meet international standards of quality and ensure that Indian industry adapts these standards at the earliest.

ISO 9000 mark may be a passport for products' entry into the world market and help to cross the barriers coming up around EEC 92. ISO 9000 standards might also become a pre-qualification for bidders at EEC. ISO certified products may enjoy a lower rate of premium for product liability insurance whereas non-certified products may be insured at a higher premium or not at all.

While these standards will result in greater degree of customer satisfaction and consistent quality, ie, right first time, right everytime, it will prove to be a key factor for cost reduction by avoiding reworks, rejects, etc.

Therefore, in the changing scenario of greater quality consciousness we have to suitably update quality standards to the satisfaction of consumers both for internal and oversea markets.

Friends, our country is vast and so are our problems — big in magnitude multi-dimensional, diverse and challenging. But we have a mighty manpower to boot, as well as rich natural resources and a proud heritage.

It is true that we have progressed since independence, but there are still many miles to go. The planners, engineers, technologists and all concerned have to work together- in a determined and sustained manner for realization of the goal — a happy, long and healthy life, education, freedom and rights for the people.

The Institution provides the engineering profession with a platform for use in assuming appropriate role in the various facets of national development. The Institution has to take a lead and offer leadership in various spheres of the nation's development.

As engineers, we are aware of our responsibility and role in the task of nation building. Let us pledge with all dedication to serve the nation al all times and on all occasions and make relentless endeavours with commitment for building the nation.

Ladies and gentlemen, I take this opportunity to wish you and your family a Happy and Prosperous New Year.

Presidential Address

(1993-94)

I am grateful to the members of the National Council of the Institution of Engineers (India) and through them to all the members for unanimously electing me as the President of the Institution for a second term. This I consider a great honour.

I am fully aware and conscious of the responsibilities of the office and the great tasks that lie ahead in realization of the objectives of the Institution. I will endeavour to come up to the expectations of our friends in the Institution .

My seniors responsible for the inception of the Institution of Engineers (India), founded more than seven decades ago, did it with great hopes and ambition. During the last decades, the Institution has grown in all directions due to devoted and dynamic leadership of my predecessors in the office, the Past Presidents. It is very encouraging that many of them are present here with us today. I seek their blessings and look for their guidance and support to carry the torch ahead.

The Institution

As India embarked on its industrial development, the status of the engineering profession became a matter of higher importance. The Industrial Commission Report of 1916-18 had emphasized the need for establishment of an institution like ours to safeguard and assure the status of the profession. This led to the emergence of the Institution of Engineers (India) which was registered under Company's Registration Act 1913 on February 13, 1920, and later formally inaugurated in the hall of the Asiatic Society of Bengal on February 23, 1921. This was followed by the grant of a Royal Charter in 1935 — the first ever Royal Charter given to a body with its origin and function in India.

As India embarked on its industrial development, the status of the engineering profession became a matter of higher importance

According to the IEI Charter, the main objectives of the Institution are: advancement of engineering science and its applications in India and to facilitate advance information of knowledge and exchange of information and ideas on those subjects. For the realization of these objectives the Institution has been playing its role on all fronts — publication of learned papers in all disciplines, establishment of library services in various parts of the country, promotion of continuing education in a new orientation, enlarging the membership profiles through diversification of technical activities, retrieval of information and utilization of relevant technology, improvement of professional qualifications, involvement in the national policy, enhancement of activities in various parts of the country through its established Centres, transmission of expertise in specific areas of reconstruction and highlighting the Institution at the highest level.

The membership of the Institution has now grown to about 400000 including about 100000 Corporate Members served through 15 Divisions, each looking to the activities of a particular discipline of engineering and through its 87 Centres located in various parts of the country. The Institution publishes technical Journals in all the disciplines and conducts technical lectures, continuing education courses, seminars and symposia. The Institution has also established forums covering different areas of specialization of intensive activities of inter-disciplinary nature. These are: the National Design and Research Forum at

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Bangalore; the Rural Development Forum at Calcutta and the Water Management Forum at Ahmedabad. These Forums have enabled the Institution to establish a chain of subsidiary units for extensive activities. The Institution has also established an Engineering Staff College at Hyderabad for developing continuing education courses through profession-oriented programmes.

Recently, courses have been designed on ISO 9000 in consultation with experts in the field and in conformity with EC requirements. These courses have already been started in the Engineering Staff College at Hyderabad and we propose to hold such courses at other places in the country. We are also trying to obtain the expertise of a professional of EC under the Indo-EC cooperation programme.

The Institution is a constituent of many world bodies and also acts as the National Committee for some others

The Institution is a constituent of many world bodies and also acts as the National Committee for some others. Apart from this, the Institution has bilateral agreements with overseas professional societies. There are 14 sister societies abroad, viz, Hungary, USSR, USA, Germany, Bulgaria, China, Yugoslavia, Poland, Czechoslovakia, UK and Nepal. The Institution acts as a National Committee for: (i) World Energy Council (WEC), (ii)World Mining Congress (WMC), (iii) International Federation of Prestressed Concrete (FIP), (iv) International Institution of Production Research (CIRP), (v) International Council of the Aeronautical Sciences (ICAS), and (vi)International Federation of Automatic Control (IFAC). In addition to these, the Institution is a constituent of: (i) World Federation of Engineering Organisations (WFEO), (ii) Federation of Engineering Institution of South and Central Asia (FEISCA), and (iii) Commonwealth Engineers' Council (CEC). The Institution has also established overseas chapters in London, Manila (Philippines), Dubai, Abu Dhabi, Bahrain, Qatar and Canada.

The Institution of Engineers (India) was host to a number of World Congresses in the past, the most recent one being during January 1992 — the World Congress on 'Natural Hazard Reduction'.

During the last one year, the Institution has been visited by a number of dignitaries. Among, them were the President of WFEO, President of IEE (London), President of Jordan Engineers Association and Chairman of Task Force on Transfer of Technology, WFEO, and President of the Institute of Engineers, Switzerland. Discussions were also held with officials of the American Society of Civil Engineers and American Society of Mechanical Engineers. These meetings were fruitful in furthering technical cooperation and exchange of technical publications and ideas for mutual benefit.

The Institution has taken up a great social responsibility — promoting professional education to the youth of the country

The Institution of Engineers (India) has taken up a great social responsibility — promoting professional education to the youth of the country. We have been conducting examinations of Section A and B which are acknowledged by employers in both the Government and private sector as being equivalent to graduation in engineering from a recognized university.

In compatibility with the requirement of the profession on the changing global scenario, the syllabi of the Institution examinations are periodically revised. The syllabus introduced in 1926 was revised in 1949, 1962, 1974 and new courses were added between 1980-84. The last revision has been done recently in 1992. This will come into force from the Summer Examination of 1993. The changed syllabus has given emphasis on training in the basic and common principles of design, production process and management of systems. Stress has also been given on computer science, environment, energy and other emerging subjects like reliability engineering, terrotechnology, non-conventional energy, production systems, etc.

Needless to mention, the Institution examinations have been very popular and the number of students taking them is growing from year to year. From 103793 in 1986, it has increased to 122411 in 1989 and approximately 163000 in 1992. This is how the Institution of Engineers (India) has been playing a big role in supplementing the stock of qualified manpower of the country.

I am happy to say that our Institution intends to provide distance education facilities, specially designed for the students taking up Section A & B Examinations. Action has also been initiated for publication of text-books and other educational aids. Besides this, various libraries of the Institution are proposed to be enriched and linked up together for effective information dissemination. To achieve this end, an Information Service Centre has been opened in September 1992 converting the erstwhile West Bengal State Centre Library to the Central Library-cum-Information Service Centre. The Institution would thus be diversifying into the area of imparting distance learning besides holding examinations only.

The Institution would be diversifying into the area of imparting distance learning besides holding examinations only

Perspectives in the Field of Education

The Institution has a great concern for technical education and therefore I may encroach upon your time to speak about the present educational dilemma and its changing faces.

Ongoing studies in the field of education reveal that the demand for education and training will assume such proportions in the coming years that present institutionalised systems would no longer be adequate for absorbing this. If the present systems are to continue, their rigid interior divisions must be redesigned.

Administrators and planners tend to take a conservative approach in matters of education; they prefer security rather than risking imaginative innovation. This is understandable because the path then is safe and cause least disturbance. Overall it remains a 'business-as-usual' approach which many time becomes 'business-worse-than-usual'.

Dr G Bishop, once Head of UNESCO Curriculum Development Projects in East Africa, and currently a Consultant in Education for the EEC opines that by and large there has been no fundamental synthesis of new and exciting educational innovations arid revolutions as have occurred in almost all spheres of life in the past 60 years. The monk's cell of that educational process is still being continued where the teacher faces a specified number of pupils arranged in regimented rows and columns, bounded within four walls, and at the sound of a bell, the whole process gets underway. What he feels needed is a re-fashioning of education, a new synthesis combining the best of the old and the modem, to form new, integrated 'systems' of teaching and learning timely geared to the 20th and the 21st Centuries.

Other experts have been bolder in declaring that rather than dragging an educational system into the 21st Century, brave new adventures must be embarked upon the adopting a radical or unconventional approach to the question of finding solutions specially for the under-developed countries.

One way of dealing with current educational problems within a reasonable of time-frame has been, as in many developing countries, to opt for linear expansion of the educational systems. This, however, soon proves to be insufficient. Another alternative is to embark bold new innovations holding promises for the future.

One way of dealing with current educational problems has been to opt for linear expansion of the educational systems

Since conventional education structures and methods are not proving to be adequate for the tasks, alternative structures and methods must be designed. This re-designing of educational process and invention of new teaching and learning systems are 'to-days' main frontier of education planning'. the objective is then to examine various alternative' systems for accomplishing the desired results; to select the optimum one and develop it to fruition.

New educational designs are usually patchwork version of old ones and therefore rarely go into orbit. This means that educational planning must move increasingly into creation and testing out of new educational designs involving fundamentally 'new systems' of teaching and learning designed to achieve well-defined performance specifications with greatest effectiveness at the least cost. If education is to help change the world and to help brighten the lives of more and more people, it must be reformed to be more acceptable.

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Status of education all over the world reveal that boldest reforms in educational innovations The changed orders in every society have assured the future of distance education have been attempted in the less developed countries where even family school education has not been so well established universally and where, as a result, it has been little opposed by traditions and practices, good or bad.

Innovation is 'planned', the idea being that through planning one can increase the chances of bringing out any desired change. So, for educational change to be effective it must be deliberately planned and rationally organized. An innovative change has to be pragmatic, preceded by careful research and based on adequate expertise. It should also be conjured by well intentioned educational administrators.

Distance Education

Distance education has had a changed phase since the 1970s due to the rapid socio-political and socio-cultural changes in almost every country of the world. The changed orders in every society have further assured the future of distance education because of the growing privatization of life in many developed western societies and the incapacity of 'campus programmes' to cope with even minimal educational opportunities elsewhere.

The changed orders in every society have assured the future of distance education

The improvements in the last 20 years have been both qualitative and quantitative. Research findings identify the attributes to be: (1) the development of new communications technology; (2) a growing sophistication in the use of printed materials; (3) improved design of instructional materials; (4) improved provision of support ser vices for the learners studying at a distance; and (5) the foundation of the Open Universities in both developed and developing countries.

Despite much attention that the system of education has received, distance education is still little known and little studied. Most research in this field has been practical rather than theoretical. While research on the practice of distance education is important and fundamental. It is incidental and peripheral to a firmly based theory. A theory is essential as this can only give the foundation on which structures of need, purpose and administration can be erected. A firm theory of distance education will provide the touch stone against which decision — be it political, financial,

A firm theory of distance education will provide the touch stone against which decision can be taken with confidence educational, and social — can be taken with confidence and this can then only replace the adhoc way of responding to crisis situations which characterise the field of education almost everywhere.

The theory is based upon four basic axioms: (1) distance education is a coherent and distinct field of educational endeavour; (2) distance education as a system of education is different from the conventional ones; (3) distance education poses multidimensional problems for administrators, teachers and students; and (4) distance education is supplementary to most national educational systems.

Different non-Conventional Education Systems in Vogue

There are two families of educational activities. The first includes all the conventional educational situations where the teacher is physically contiguous with his students, the communication is vocal and in which the teaching is a service that is consumed simultaneously with its production. The second family of teaching includes situations where the student is separated from the teacher and the communication is facilitated by a mechanical or electronic medium. Teaching in this environment is consumed at a time or place different from that at which it is produced. To reach the learner, it must, therefore, be contained, stored, transported and delivered; if interaction is to be there, it is delayed to some extent for various reasons.

Recently, 'Distance Education' has been exposed to elaborate discussion. The definition may be characterized by:

(1) The quasi-permanent separation of teacher and learner throughout the length of the learning process;

(2) The influence of an educational organization both in the planning and preparation of learning materials and support services;

(3) The use of technical media — printing, audio, video or computer — to unite teacher and learner and carry the content of the course;

(4) The provision of two-way communications to initiate dialogue; and

(5) The quasi-permanent absence of the learning group throughout the length of the learning process so that the learner is taught as individual and not in groups, with the possibility of occasional meetings for socialization purposes.

The Development Process

Since independence, the objective of our development efforts have primarily been the fulfilment of the social and human aspirations of the people, meeting the essential requirements of living, raising income levels and improving their quality of life.

Our developmental efforts have primarily been aimed at improving the quality of life of our people

Our experience tells us that the major factors determining the long term conditions of growth are the demographic trends, the basic resource endowments, the entrepreneurial resources and the technology perspective. The growth and the structure of population together with the labour force make up the elements of demographic trends while the sources of energy, land, water, other essential minerals, environment and ecology make up the resource endowments. Technology plays its role to augment the basic resources by raising their productivity, and conserving their uses thereby altering the comparative advantage. Access to the best technology in all spheres of activity and ability to take a lead in building up new technologies (ie, making innovations) even in a small sphere of activity are going to become the most crucial factors in determining our development pace vis-a-vis other countries.

In Retrospect

We find that our process of development started formally in April 1951 with the launching of the First Five-Year Plan. Our aims were raising our peoples standard of living, meeting their aspirations and opening out to them new opportunities for a richer and a more varied life. The route chosen was planning for growth, modernisation, self-reliance and social justice.

A lot of progress has been done since then. A largely agrarian feudal economy has given way to a highly diversified infrastructure with immense potential for industrialization. Income and consumption levels have risen; the consumption basket has diversified. Incidence of poverty has declined, life expectancy and educational levels have improved. Our country today has a diversified industrial and service infrastructure and a resilent and robust agricultural base.

I would like to share with you my thoughts on some of the important areas of development.

Science s Technology (S & T)

Science & Technology is the key to development now and in the future. It is important not only for industrial development which may bring about economic upliftment, but it is also becoming increasingly important for behavioural, psychological, sociological, cultural and other developments.

Science & Technologv is the key to development now and in the future

With a long cherished scientific tradition, our country has, over the years of its growth, developed a considerable scientific and technological potential. India has to forge ahead and, for this, the S & T base has to playa pivotal role in all the important tasks that lie ahead of us. The effective transfer of technology from the research institutions to industries and a more meaningful deployment of S & T as a tool for growth and change should be the imperative strategy. S & T and its associated methodology must be brought into the central theme of our developmental planning for effective utilization of our scarce resources. Brain drain-and unnecessary import of technologies in the non-essential sectors are two important areas which need to be avoided.

One of the challenges faced by S & T is how to produce more from less. Out of the several ways through which this may be possible, that of conservation takes the forefront. Another avenue is consolidation of existing position in different sectors through indepth reviews and purposeful modernization of the manufacturing industry for high quality and productivity. Commitment to excellence in everything we do has to become an essential ingredient if our endeavours have to yield results commensurate with our needs. Quality improvement in our products and related efforts would increase the demand for S & T, not only in concepts and design but right through selection of materials, production, testing, packaging, transportation of goods, marketing and post-sale activities. These would, in term, create greater employment opportunities. But the most important factor is that the culture of scientific processes must percolate in the entire population for accelerating the results and increasing the quality of life of the people.

The culture of scientific processes must percolate in the entire population for increasing the quality of life of the people

Energy

Energy is a vital resource which is in short supply. To meet the growing demand for energy from households, industry, transport, agriculture and trade will be a major challenge ahead of us. This challenge is accentuated by the fact that the pattern of demand for energy is also changing. Analysis of total commercial energy consumption shows that there is increasing trend in consumption of fossil fuels, natural gas and electricity.

Today, when we are faced with the imminent threat of depletion of natural sources of energy, measures will have to be initiated for reducing the energy intensity in different sectors through changes in technology, processes and substitution. The main emphasis will have to be on maximising renewable sources of energy with affordable cost for low income groups. A major stress should be laid on efficiency, conservation and demand management.

A major stress should be laid en efficiency conservation and demand management

Recent studies have shown that the consumption requirement of electricity will be around 622 TWh by the end of the next fifteen years. With various technical measures adopted and system improvement schemes undertaken in various States, the system losses are expected to go down by atleast 7%. Taking this into account, the total generation requirement would be 798 TWh. Non-utilities are expected to contribute about 45 TWh. The generation requirement from utilities will be to the tune of 749 TWh besides import of 4 TWh.

To provide for more power availability with the available resources, it is essential that the plant load factor (PLF) be improved. Also necessary is a judicious mixture of all the available energy sources — renewable and non-renewable; conventional and non-conventional. We are fortunate that our country has vast potential in terms of wind, water and solar energy. We have also exercised the nuclear option at some places. The techno-economic feasibilities as well as the social consequences of the various types of sources of energy need to be worked out afresh keeping in view our national objectives. The keywords in our endeavours should be efficiency and conservation.

Agriculture

Agriculture has been the backbone of our national development. The strategy for agricultural development must aim at not only achieving self-sufficiency' in food but also generating surpluses of agricultural commodities to meet needs of the growing population; for reserves and exports. Though the progress of agriculture in the recent period has been satisfactory, there are striking regional and crop imbalances. Productivity varies considerably from one region to another. The benefits of Green Revolution which has been largely confined to specific regions must spread out to other areas which have adequate rainfall, fertile soil and unlimited scope for stepping up agricultural production. In the absence of total irrigation, greater emphasis has to be laid on dryland farming for balanced regional development. A concerted effort towards increasing production of high yielding varieties of seeds, improved fertilizers and improving the overall soil-nutrient value, and creating better storage facilities are essential. Two-thirds of the workforce still depend on this sector and if we are to aim for total development, this sector should continue to receive priority attention.

Environment

We are at the midst of a variety of critical environmental threats degradation of soil, water, and marine resources essential to increased food production; wide spread health-threatening pollution; stratospheric ozone depletion; global climate change and loss of biodiversity. The world also faces enormous human problems such as persistent poverty and human misery and an inequitable and worsening economic growth pattern.

Sustainable development essentially aims at significant progress towards stable population. Environment, ecology and development must match to meet the needs of the society. It is in the interest of sustainable development that measures be adopted preserve, conserve and nurture

Sustainable development aims at significant progress towards stable population our fragile and critical eco-systems. Sustainable development entails making full use of human resources by improving education and health services and by fighting hunger. Thus, it would mean redirecting and reallocating resources to ensure that basic human. needs, such as literacy, primary health care and clean water are met first. Beyond basic needs, sustainable development also means improving social well-being, protecting cultural diversity, and investing on human capital.

There is need for another look at our environmental options. A decentralised approach percolating to the grassroots level in every sector of development with definite definitions of appropriate technology while formulating developmental programmes and projects is imperative.

A decentralised approach percolating to the grassroots level is imperative

Environmental 'success' can be accomplished only with the fullest cooperation of the people. The support of governmental and non-governmental agencies for this is important.

Environmental 'success' can be accomplished only with the fullest cooperation of the people

I refer to my views expressed last year that a developing country like ours has to direct its resources towards immediate concern. There are constraints under which we have to execute developmental programmes; which are quite different from those of the developed nations. The underdeveloped and the developing countries need to be helped technologically and monitorily to trade-off, the increasing cost of projects with environmental concern. While concern for the environment is important for our continuance, a logical mix of environmental concerns and developmental options is necessary.

Employment

Expansion of employment opportunities has been an important objective of our developmental efforts. Larger and efficient use of available human resources is the most effective way of poverty alleviation, reduction in inequalities and sustenance of a reasonably high pace of economic growth.

Employment generation and economic growth are two mutually complementary processes. Employment, to be productive in character, should be able to yield a reasonable level of income to the worker and also generate surplus for further growth and employment generation.

One unfortunate impediment in our economy has been the low productivity of our work force, involuntary idleness together with low wages level. An overwhelming majority of the poor are thus not apparently unemployed, but are engaged for a major part of their time in some activity, although at very low levels of productivity and earnings. Our aim should, therefore, focus not only on the creation of new jobs, but also on the augmentation of the existing employment in terms of productivity and income through suitable technologies, market and institutional support.

In the current scenario of rapidly changing technologies and work organisations, the demand for labour cannot always meet the characteristics of labour supply. A mismatch between skill and other requirements of new opportunities and the attributes of available workers is bound to give rise to shortages and surpluses. In such a situation, it would be necessary to intervene in the supply side of the labour market and devise ways and means of improving the employability potential of the available

It is essential that structures and arrangements are made available for the training and skil upgradation of the labour force to adapt itself to rapidly changing job requirements workers. It is also essential that structures and arrangements are made available for the training and skill upgradation of the labour force to adapt itself to a rapidly changing job requirements and therefore the potential employers need to be involved actively in the planning of such systems.

Inspite of adverse circumstances, the engineers of our country have played their role in rebuilding the country

Friends, this is the time when we should assert our importance, our competence and our fervent desire to serve the nation. Ignoring many hazardous pitfalls obstructing the path of progress, our country, since Independence, has been marching ahead and achieving success in diverse fields. These accomplishments are not accidental. Behind all our successes we have the untiring efforts of our scientists and the engineers. Inspite of certain adverse circumstances, the engineers of our country have played their role in rebuilding the country, and in this scared mission we stand second to none. We have never wavered in our commitment to the people, in our pledge to toil for their welfare.

At present, the country, as we all know, is passing through a difficult time, and we are as eager as ever to do our best to meet the challenge.

Our experience tells us that we can move best and work most effectively when we move collectively and work as disciplined members under the inspiring guidance of an established Institution. One of the guiding factors for the establishment of the Institution was for safeguarding and promoting the status of the profession. However, the status of the engineers specially in spheres of policy making is still low. In the interest of national progress this has to be amended.

Our Institution has grown in strength, enlarged and increased its activities and contributions. Let us get inspired by the prestigious heritage of the Institution in promoting the image of the engineers, unfold realities before the people, the people's representatives and other high-ups in the administration on the value of engineering knowledge in the development of a nation.

We stand for professional competence, unattached action, quest for perfection, adaptability to change and freedom from fear.

Shri G P Lal—a Brief Profile

Shri Ganesh Prakash Lal, B Sc (Engg) (Hons), BL, FIHE (London), C Eng, FIE, (b January 28, 1929) started his professional career in the Public Works Department, Bihar, in 1952. He was promoted as Executive Engineer in 1959. Constructions for concerning the establishment of new District Headquarters at Dhanbad, construction of buildings in the campus of Bihar University at Muzaffarpur and lateral road in Purnea District are some of the notable works done by him as Executive Engineer. Shri Lal had the opportunity of Special Study assignments related to the construction of roads and buildings in motorways in the UK under the Colombo Plan in 1964.

Promoted as Superintending Engineer in 1970, he remained in charge of National Highways in 1975; was appointed as Director-cum-Chief Engineer, Bihar Police Buildings Construction Corporation, and later he became Managing Director of the Corporation. In 1983, he was appointed as Chief Engineer, Building Construction Department, Government of Bihar.

An outstanding engineer, administrator and planner, he was promoted to the post of Engineer-in-Chief-cum-Additional Commissioner (Works)-cum-Special Secretary to PWD in the Department of Roads, Government of Bihar, in 1986. In the following Director, Bihar Rajya Pool Nirman Nigam from where he retired in 1989.

Shri Lal's devoted association with the Institution, of which he is a member for nearly 30 years, has been memorable. As a staunch champion of the cause of the engineering profession vis-a-vis development of the Institution, the significant services rendered by him are already so well known. He has been member of the Executive Committee of the Bihar State Centre of the Institution since 1973. He was Honorary Secretary of the Dhanbad Local Centre during 1972-73 and became its Chairman in the following year. As a member of the National Council since 1975 he has done yeoman service in the cause of the Institution. He was Chairman of the Bihar State Centre for the sessions 1976-78, Chairman of the All-India Students' Chapter during 1981-83, Chairman of the Civil Engineering Division during 1983-85, and member of various Committees and Forum of the Institution during the last 16 years. He was associated with the establishment of the Dhanbad and Muzaffarpur Centres and the Paper Centre at Bokaro Steel City.

Shri Lal represented the Institution as Deputy Leader of the Indian delegation at the Congress of the Federation Internationale de la Precontrainte (FIP) held in Stockholm in 1982. He was Leader of the Indian delegation to the Annual Convention of the Institution of Engineers (Pakistan) held in Lahore in 1987; and delegate to FEISCA (Federation of Engineering Institutions of South and Central Asia) Conference held in Colombo in 1988 as member of the Task Force on Habitat.

Shir Lal is affiliated to several professional bodies. He has been Vice-President of the Indian Concrete Institute during 1985-87 and Chairman of the Bihar Centre Local Organizing Committee since 1987. He has been a Fellow of the Institution of Highway Engineers (UK), Member of the Nepal Engineers' Association, Member of the Indian Roads Congress, and member of the Indian Council of Arbitration. He is also a member of the Board of Governors of the Birla Institute of Technology (BIT), Mesra, Ranchi.

A reputed philanthropist and social worker, Shri Lal has been District Governor of Lions Clubs International (comprising Bihar and Nepal) during 1980-81, and is a member of the Multiple Council of Lions Clubs of Eastern India and has championed the cause of the poor. He has been decorated with the award of Abhiyanta Ratna by Engineers' Club, Bihar on Engineers' Day, 1991.

He is Director of the Gaya Regional Development Authority, a former Directory of the Patna Regional Development Authority and an ex-Councillor of the Patna Municipal Corporation.

A very widely travelled man, Shri Lal has participated in many international and national Seminars and published technical papers. His sagacity and expert knowledge in analyzing oncoming challenges could be understood by his organizing Seminars on such vital topics as 'Atmospheric Pollution' and 'Environmental Pollution' at Dhanbad in the early 70's and 'Safety in Construction' and 'Construction Contracts, Disputes and Arbitration' at Patna in the late 70's. He has also successfully organized Seminars on 'Setting-up of Industries in Bihar' (Patna, 1978), 'Voluntary Organizations and Community' (Patna, 1979), 'Appropriate Technology in Road Construction' (Ranchi, 1986), 'Bridge Design and Construction' (Patna, 1988), 'Shelter for Millions' (Patna, 1979) *and 'Safety and Hazard Management in Chemical and Allied Industries' (Patna, 1991) and many others.*

An eminent personality in the engineering profession with profound dedication to the cause of progress and -the advancement of his fellow professionals, Shri G P Lal brings in a new dynamism to the Institution. His election to this exalted position is sure to make the profession stronger and enable it to contribute in more and better ways to the welfare of the nation. The profession fervently looks forward to this enlightened leadership, guidance and support in its continuing efforts to serve the nation.

Shri P M Chacko
President 1994-95 & 1995-96

Presidential Address
(1994-95)

The Institution of Engineers (India), now in its 74th year, has a glorious heritage. Over the years, it has stood witness to many technological achievements — big and small, by many individuals who had been a part of this great Institution; many had been engineering visionaries; their visions still have contemporary relevance.

As I assume the highest office of this august body I feel honoured by the confidence bestowed on me by my colleagues in the Council and overwhelmed by the responsibility that goes with it. It will be my endeavour to carry on the great work done by my predecessors in this high office to the best of my abilities.

May I take this opportunity to convey on behalf of all present here and all the members of the Institution as also on my own behalf our sincere gratitude to the retiring President Shri G P Lal who so ably led the Institution for two years.

I also pay my respects to my predecessors in office for the meritorious work they did. It is their inputs which made the Institution what it is today. I shall count on their wise counsel during my term of office. I am encouraged by the presence amidst us today of many Past Presidents. I seek their support and blessings.

Seventy four years ago, the Institution was formed by a few people. Today we are almost 400000 strong. The Institution has under its umbrella 15 distinct engineering divisions. Each division organises its own seminars, workshops and National Convention every year to disseminate engineering advances and foster wider interaction amongst members. Besides these, we have specialised interdisciplinary forums concentrating on a particular field of activity. The National Design and Research Forum has been established to encourage research while the Water Management Forum encourages studies on water distribution and conservation. The Rural Development Forum identifies the important link between modern technology and traditional value systems particularly in the rural setting. The Interdisciplinary Group on Sustainable Development approaches the avenues leading to sustainable development from an interdisciplinary point of view. For continuing education. the Institution has incorporated the Engineering Staff College at Hyderabad.

In addition to 87 Centres in India through which its activities are taken to the members. the Institution has bilateral relations with 14sistersocieties abroad. It acts asa National Committee for the World Energy Council (WEC). the World Mining Congress (WMC). the International Federation of Prestressed Concrete (FIP) the International Institution of Production Research (CERP). International Council of the Aeronautical Sciences (ICAS) and the International Federation of Automatic Control (IFAC). Besides these the Institution is a constituent of the World Federation of Engineering Organisations (WFEO). Federation of Engineering Institutions of South and Central Asia (FEISCA) and Commonwealth Engineering Council (CEC). There are overseas chapters of our Institution in Abu Dhabi, Bahrain, Dubai, Oman and Qatar.

The issues of interest to the Engineers are many. However. I would touch upon only a few of those which are of immediate concern.

Industrialisation

In over four decades of post independence era. our industrial policy had been characterised by a high degree of government intervention. A significant portion of industrial activity was under government ownership and public investments constituted a considerable portion of total industrial investment. Indirect control was mainly exercised by the instruments of investment licensing. import licensing. price controls. foreign investment restriction and product reservations. In recent years. these controls have come under heavy attack and are held responsible for the slow growth patterns of productivity and low efficiency in Indian industries. Consequently. the need was felt to relax these controls and usher in an era of liberalization and reforms.

The initiation of this era was marked by the announcement of the New Industrial Policy. The new policy statement aims to consolidate further the gains on the industrial front already made and also correct whatever weaknesse sit had. For the first time perhaps, in the history of Indian industry was a policy statement made which stressed on competitiveness, efficiency, technological and manpower upgradation and capacity utilization. In the last Engineers' Day— the engineers all over the country celebrate September 15 as Engineers' Day every year when a common theme of engineering having contemporary relevance and of national interest is selected and discussed at all the centres of the Institution and recommendations communicated to industries, governments and others for their benefit—we had discussed the challenges engineers face due to this liberalization. In this Congress, we consider a related topic "the Role of Engineers in Strengthening Self Reliance".

With the advent of liberalization, the industrial scenario in the country has undergone rapid transformation. The economic reforms have demolished decades of stifling industrial controls. The trade and exchange regime has been radically reformed opening up the country to foreign participation in capital and technology. The concept of universal competitiveness has come to occupy centrestage. The reform process has brought with it the gospel of globalization. This theory demands that the successful company of tomorrow be globally competitive, sell its products and services worldwide and be in totality more responsive to the changing demand patterns of the market it serves.

This opening up has brought with it both challenges and prospects. It has spurred industrial growth in a pattern not hitherto seen in our country. Tremendous opportunities have been thrown open to the country in general and the engineers and technologists in particular.

The industry of today is not viewed in isolation but in the global perspective of rapidly changing circumstances. It is now imperative that our products are made more competitive in the global context in terms of both quality and cost. A strong technological base has to be built up to supplement foreign technological offerings. The development strategy will have to be reoriented into making our products and services more competitive, more acceptable and aligned to the export market. State-of-the-art technology has to be adopted. Research and development has to be more innovative and close research industry linkages have to be developed and maintained to fend off technological obsolescence. Indian engineers and scientists will now have to gear up to the challenges of the day. It is evident that in the changed circumstances only those organizations which have technological or commercial superiority and global acceptance will survive. The key factor is to reform the Indian industry to the global setting.

The need of the hour was quite evident from the recent message of the Finance Minister to the industry. As an extention of the common adage 'Industrialise or Perish', the industry was given the new message 'Reform or Perish'.TheMinisterhasrightly asserted that the Indian industry, in order to survive, has to evolve a definite time bound programme to modernise and integrate itself to the global economies.

It is as yet too early to judge the effects of the recent liberalization on efficiency, employment and income distribution. Some have predicted that, at least in the short run, the liberalized import of foreign technology may tend to cause a decline in our own R&D efforts. The National Design and Research Forum of the Institution functions to get together experts in the R&D field in selected areas and conveys the conclusions and recommendations to those concerned to enable everyone to benefit therefrom.

Our technologists should examine the inherent strengths and weaknesses of the economy and judge accordingly. Being basically an agrarian economy, the country has definite strengths in areas related to agriculture. This needs to be exploited to the fullest. The application of modern technology in the rural areas holds the promise of upliftment of a major section of the population as well as economic improvement. But, the technology used has to be relevant and appropriate and should also make use of the available resources without upsetting the traditional rural setting; it has to be necessarily eco-friendly.

The Rural Development Forum of the institution has been making efforts in this direction to help in achieving a proper synthesis of modern development and traditional values. The Water Management Forum of the Institution does commendable work in studies related to water sources, storage, effective utilisation and all related technological and management aspects.

The Gatt Agreement

The Dunkel proposals and the eventual Gatt accord have created a wide range of emotions. Some people fear that it will create man-made price escalations, shortages in essential items and even famines. Others see a silver lining and a brighter tomorrow. The situation appears somewhat nebulous and confusing not only to the uninitiated, but even to those who otherwise were relatively well informed. The ramifications are perhaps unpredictable; however the setting calls for continuous follow up and close scrutiny. May I refer to some projections on the agricultural front.

The stipulation that developing countries should cut direct subsidies on agricultural goods or product subsidies as well as subsidies on agricultural inputs to less than 10%of the product value compares favourably with the figure for developed countries of 5%.

This need not perhaps worry the Indian farmer. A recent study reveals that non-product subsidies now amount to around 5.2%. Moreover, the National Council for Applied Economics Research (NCAER) reveals that there is a net tax of around 2.3% on Indian agriculture. That agriculture is heavily subsidised therefore does not appear well supported.

Consider these facts: The Japanese farmer enjoys 72.5% subsidy; the South Korean 60%; those in the European community between 25 and 50%; and the US farmer 26%.

These subsidies will have to be cut. The net result will be that the market will be inundated by agricultural products from the developing countries if they seize the opportunity. This can turn out to be a boon to the Indian farmer.

The world is gradually coming closer. Trade barriers are being dismantled; differences are dissolving. Inter country cooperation is on the rise. Let us put in our best to make the most of the current and developing situations.

Energy

Energy is a resource that has been in short supply. It is a yardstick measuring industrial development as also quality of life. Currently, the total energy supply picture has been dominated by conventional 'fossil' fuels with contributions also from hydro power and nuclear sources. Other sources, termed as 'non-conventional' or 'renewable' are not yet developed to any great degree and therefore cannot be compared to conventional sources. One major hurdle in achieving commercial status in these renewable sources is that they are widely distributed and relatively diffused. Supplies are essentially limitless — most are also environmentally benign. Perceived as expensive and unreliable when compared to current sources, renewable sources however hold much promise in an energy-starved world. However, present trends have shown that capital costs for renewable energy projects are decreasing and its reliability is increasing. With increasing debate on the balance of the environment and energy economics, it is clear now that the potential and contribution of renewable energy sources will be a key factor in future developmental issues.

In addition to the conventional hydro source, the renewable energy sources include, inter alia, the following areas of interest: solar, wind, geothermal, biomass, ocean and hydrogen. In our country some of these such as solar, wind and biomass have seen some development. But these efforts have been sporadic and have not yet been integrated into the mainstream. It is in this background that one has to view the laudable efforts, of late, by the Government of India to give a thrust to production of energy from non-conventional sources and all related developments. On its part, the Institution of Engineers is contributing its mite by spreading the message:

a) that the conventional energy sources, particularly the fossil sources are exhaustible and are to be consumed at regulated levels only

b) that renewable energy sources have to be relied upon to the maximum extent possible

c) that the subject of energy from non-conventional energy sources should be given utmost priority on commercial basis and for captive needs

d) that all energy generation in future shall be environment -friendly.

In our quest for rapid industrial and agricultural development we are constantly widening the gap between energy availability and energy needs.

By1997, unless an additional 38000 MW of generating capacity is installed, the Indian economy may run out of 'power'. The Planning Commission's working group on power has estimated a peak load demand of 86000 MW at the end of the 8th Plan period. To meet this demand matching additional generating capacity must be installed simultaneously ensuring that the present inefficiencies of generating stations do not degenerate further. If however, we can improve the peak levels of generation to 75% of the installed capacity as against the present 65%, we would have achieved something remarkable; also the cost of setting up about 10000MWstationswould have been saved.

Other areas requiring immediate attention include

(i) reduction of transmission losses
(ii) power factor improvement
(iii) use of equipment with higher mechanical and electrical efficiency
(iv) disseminate information about energy planning and available technologies

We can ill afford to forget that energy saved is energy produced; also energy saved is foreign exchange saved.

The development of energy sources required for overall industrialization is capital intensive. Endowed with limited natural resources, our best alternative may be the renewable energy sources. This, however, calls for large scale technological assistance mainly from developed countries who hold the technical repository for such projects. We must simultaneously embark selectively on those of the lines, best suited for indigenous development.

Human Resources Development

The foundations of agricultural and industrial advance lie ultimately in the availability and appropriate deployment of human resources. Although our country has the third largest pool of skilled technical manpower, the capacity of the system to absorb fully these skills in productive employment has been less than adequate. At the farm or the shop floor level. average productivity levels are lower than what can be attained by the known technology. One of the attributes of such dismal performance is the glaring mismatch between education, more so technical education, and industry. It is unfortunate that in our country, both run like parallel lines — each being improved in its own way — but never actually meeting. However, close interaction between the two can be mutually beneficial for innovation and higher productivity. Linkages between the two has to be evolved. They may include:

- Joint development of curriculum and educational programmes
- Industry sponsored research projects
- Setting up of science and technology parks in conjunction with educational institutions
- Comprehensive manpower planning.

In the development of manpower, educational and research bodies, professional institutions and industry have a concerted role to play. The Institution of Engineers (India) has been playing its part in:

- Conducting non-formal education and examinations
- Creating an awareness on the benefits of technology in the societal context
- Promoting relevance and excellance in engineering and technology
- Nurturing awareness on the necessity for continuous skill upgradation.

It is also our endeavour to transform the value system to stress more on productivity and quality of manpower and instil the basic concepts of professional ethics.

What Pandit Jawaharlal Nehru said many years ago still maintains its relevance:

If you wish to plan for a year, sow seeds
If you wish to plan for ten years, plant trees
If you wish to plan for a lifetime, develop man

The wealth of a nation lies in the skill of its people.

Information Technology—HRD Synthesis

The world is witnessing phenomenal growth in the development of information technology. These changes have impacts both wide and far reaching in their implications—generating new products and processes as well as new players in the global scenario. The synthesis of telecommunications, informatics and the electronic media is leading the process in this new found revolution.

For the developing countries the application of this 'new found' technology to one area of prime need — human resources development (HRD) — is important. HRD today is as much a corporate imperative as any other preferential goal. The current setting of keen competition makes HRD a sheer necessity rather than an option, let alone a luxury.

The Indian economy is changing from an agricultural to an industrial to a service-oriented one. In the next decade, the services sector promises to open more opportunities than ever before. However, there is the paramount need to improve the incremental capital output ratio. In the context of the growing population there are immense pressures on the country's resources-economic and physical. Developing the human resource potential with the utilization of information technology promises to catalyze the collective effort and a better quality of life. The competitive global environment today necessitates strategies to develop an organizational structure and human resources planning to support skill and growth needs. For survival, organizations should promote organizational effectiveness and productivity, increased responsiveness, high service levels and customer satisfaction. Computer literacy and training for sales, support and management have become major components.

In the light of rapidly changing technologies and their perception, non-conventional methods of training need to be adopted. The use of television, satellite communications and informatics in imparting basic and continuing educations may have to be explored. Manpower in fast changing and dynamic environments will have to undergo continued skill upgradations to carry an organization through the challenges of tomorrow.

However, not all aspects of such unfettered use of technology can be considered positive. More information may at times mean more conflicts and dehumanization. Very often, the technological innovations produce an unanticipated backlash. The reason for this outcome may be excessive focus on technological issues without adequate consideration to human factors.

Human resource professionals would have to anticipate and harness these threats through effective blend of information technology into the Indian value systems. The three sensitive aspects of humans — feelings, attitudes and behaviour — need to be properly assessed and considered in the definition of education and training objectives. Applying information technology to HRD thus means much more than just imparting computer skills.

Quality

Quality has been defined as the degree of excellence at an acceptable price and the control of variability at an acceptable cost. Quality is identified as 'conformance to requirements'. Any deviation from specifications implies a reduction in quality. Excellence is equated with meeting specifications.

The breadth and complexity of new demands for quality are reflected in the realities of today's market place. Buyers today are emphasising clearly that the satisfaction they seek in their purchases is a total value concept of quality, consisting of economy, safety, servicability and reliability.

As the society itself is continiously redefining the standards of living in terms acceptable to all of us in our dual roles as consumer and producer, the concept of products and services as well as technological and manufacturing process that produce the same are undergoing rapid changes.

The changing scenario requires management to approach product consumerism positively and underlines the need for control of quality of all aspects of business strategy; in organisational or functional areas like marketing, engineering, manufacturing, distribution and maintenance — all of which are essential to meet customer's expectations. Unless the strategic implication of the concept of total quality on overall business performance is properly understood by management and all employees of the organisation and reflected appropriately in the strategy being pursued, the ultimate objective of continuous improvement of quality products and services to the level demanded by the customers will never be realised. The explicit focus and continuing commitment of top management to support quality programmes are critical for achieving excellence in this area.

When one takes into account such benefits of total quality programmes as improvements in product design and quality, reduction of operating costs, improvement of employee morale, removal of production line bottlenecks, etc the strategic importance of total quality management becomes obvious. The supplementary advantages are no less important either. Examples are: improved inspection and testing methods, former setting of line standards for production processes, definite schedules for preventive maintenance, availability of key data for use in product and corporate advertising and better information on operation. Good organisations recognise the financial payoffs from these benefits in much more clearer terms and are thus able to evolve a right mix of strategy, values, structures, systems and people that helps in achieving these benefits and along it the comparative advantage and long term customer patronage.

In short, quality is the pursuit of excellence; conforming totally to demand specifications, meeting user requirements, and doing everything right the first time. It is not, as many think, something immeasurable or vague or an incomprehensible cloud of semantics floating over our heads.

The Institution, under the auspices of the Engineering Staff College, has been organising awareness and training programmes on ISO9000. Efforts are also underway for tie-ups with other professional institutions for building up quality management programmes.

Sustainable Development

Over the years, many countries have developed and adopted environmental strategies aimed at controlling a set of specific pollutants. These actions have been aimed mainly to contain direct contamination of land, water and air as well as indirect and regional effects such as damage by acid rain, toxic wastes and the like. The environmental effects of legislations and regulations have been reduction in pollutions. In many cases, there have been improvement in quality of air and water. but overall, these control effects have resulted in little more than holding action. New pollutants and new threats have emerged — from local concerns to global issues like stratospheric ozone depletion and climate change.

Most environmental strategies have been to control 'end-of-the-pipe' discharges designed to neutralise hazardous wastes already created. Little concern has been showed to altering the industrial. commercial. agricultural or consumer practices with a specific intent at avoiding or at least reducing substantially the waste in the first place.

The Engineer has a definite role to play in this context. He should realise the responsibility that society puts in him and in turn care for the effects of his doings beyond his immediate domain of activity. He should learn to see himself as an agent for an upheaval in social and cultural fields. Society expects the engineer to realise this and be assertive — to initiate steps to ensure sustainable development; to cut down wastes to the minimum possible level and extracting the maximum practicable technological advantage from wastes by creating useful by-products. Through proper R&D, it is possible in many instances to satisfy the ecological needs and simultaneously engineer creation of useful by-products. Let us make a conscious and dedicated effort in this direction, to make wealth out of waste.

This is where one's vision comes into play. As engineers, can we train ourselves to anticipate rather than react, to look beyond the demands of today at the challenges of tomorrow and provide long term answers instead of temporary solutions. The society expects this of us engineers. Let us not fail them.

Presidential Address

1995-96

Friends,

My fellow Members of the Council of the Institution have re-elected me as President during the Platinum Jubilee Year. To them all, I wish to express my deep gratitude. This makes me conscious more than ever of the responsibilities and high expectations. I would like to assure my colleagues in the Council and the general membership of the Institution that I shall strive towards this ceaselessly. In this, I seek the support, involvement and guidance from my respected colleagues in the Council.

Steps taken last year in areas of general administration, membership generation and growth, matters relating to students and technician members including examinations, technical and publication activities, Headquarters/State Centres/Local Centres relationship, etc will be pursued with vigour in the background of the experience gained last year.

The past three months of the Platinum Jubilee year have witnessed numerous activities of high standard at various State and Local Centres. I congratulate the Chairmen and Committees for this. My wish however is that the remaining nine, months of the Platinum Jubilee year should see many more activities of a level the Institution could be proud of. With the impetus that we have received during the celebrations here with the participation of Rashtrapatiji and other renowned personalities in our apex function, I am confident that activities will accentuate further. My role will be that of a catalyst and I offer my services in this connection.

An area which needed specific attention, in my opinion, was closer relations with various engineering ministries at the Centre, the Planning Commission, large industrial undertakings, etc. A beginning was made last year, but a lot more remains to be done. Our efforts will continue. I am happy to record here that the responses are overwhelmingly encouraging.

International Linkages

International activities certainly needed a boost. Our functioning as the Indian Member Committee of the World Energy Council (WEC) was undoubtedly the most prestigious amongst our international linkages. It was unfortunate that this relationship had got derailed. I am happy to place on record in confidence that this has been restored and we can look forward to a glorious future in this relationship reminiscent of the past. I recall here the Twelfth World Energy Conference in Delhi in 1983 which was a stupendous success leading directly to the establishment of the most prestigious forum we have, viz. the Engineering Staff College of India at Hyderabad. Initially set up for energy related studies, it has spread its wings to Continuing Education and Quality Movement as demanded by the circumstances and needs of the country.

I would like to mention here of the successful international conference on Energy on the theme "Energy for Tomorrow's World: Concerns & Issues of Developing Countries" held in Delhi in November 17-18, 1994 under the auspices of IMC-WEC. This was an instance of a challenge being accepted, faced squarely, converted into an opportunity and concluded as a resounding success. Our representatives also made a positive contribution at the WEC Executive Assembly Meeting at Cape Town in October, 1994 and we are slowly but steadily regaining our rightful place in this prestigious world body.

Engineering Information Service

Ready access to information is a major input for advancement of Engineering education, training and professional practice. In recognition of this requirement, the Institution has established the Sir R N Mookerjee Engineering Information Service Centre at the Headquarters in Calcutta. According to the planning which was completed during the year, the centre as a constituent member of the National Information System for Science and Technology (NISSAT) will have facilities for electronic linkage with Calcutta Library Network (CALIBNET) and other National and International Libraries and Information Processing Centres including major libraries located at other Institution Centres. Beginning at Calcutta, further activities are proposed to be spread subsequently to other metropolitan cities. When fully developed the Centre will be a great boon to professional engineers, academicians and research workers in search of information.

Non-Formal Education

The Institution, as you all know, is the pioneering body which had introduced non-formal technical education in the country. The examinations conducted by the Institution are recognized by Central and State Governments as equivalent to a degree in engineering. In its role as a qualifying body the Institution has opened up tremendous possibilities for those who aspire to become engineers but have neither the means nor the opportunities to pursue a formal engineering degree course. To reach this diverse section of aspiring students, the Institution is embarking on 'Distance Learning' schemes, proposing to utilize all the available current technology in the field.

Status of Engineers

Engineers play a crucial role in the development of the country. However, society and the government are not according due recognition to them nor are the engineers being associated at the top decision-making levels to make the best utilization of their specialist education and training. In a society in which great weightage is given to the authority and influence a person' has in administration, engineers have unfortunately been left out. This has not only caused frustration and a sense of discrimination, today we are also faced with a phenomenon in which a lot of bright engineers tend to leave their profession for non-engineering jobs. This is unfortunate and an important aspect which no country on the threshold of major expansion can ignore. To arrest such dismal situations, we feel that changes in administrative steps are necessary. The Institution is seized of the situation and representations/ consultations are regularly done with the concerned authorities.

The Current Scenario

The Indian economy is currently undergoing vast program of structural reforms aimed at creating the basis for a market-driven economy integrating with it the societal compulsions of a developing economy. The strategy of reforms centres on three main objectives:

• The creation of a competitive industrial structure through a judicious combination of state-run and private enterprises, the break-up of monopolies, and the dilution of direct state control in the management of organizations.

• The creation of a system of incentives that follows the signals and rules of the market by re-establishing through the gradual abolition of subsidies and price-controls and by the reform of mechanisms for investment finance and of the tax system.

• The introduction of incentives and disciplines of the world market through trade liberalization, openness to foreign investment, and the adoption of exchange rates that create direct link between domestic and international prices.

The process of deregulation and the policy of competition have aims and methods that partly coincide. Their impact on industrial process is both direct (eg, deregulation in the manufacturing sector) and indirect (as in financial markets). Apart from the basically domestic policy dimension, the international dimension of deregulation and competition policies have gained considerable importance. As the process of globalization in 'industry moves on, effective policies of deregulation and competition cannot be formulated exclusively on domestic grounds; they have to be implemented in accordance with international rules. The importance of harmonization and establishment of internationally accepted rules will thus grow as an issue in the area of competition policy.

The internationalization of industrial processes has also led to the blurring of borderlines between deregulation, competition and other policy areas and thus requires increased policy coordination.

Deregulation and Competition

As growth and global competitiveness are seen to depend to a large degree on the capacity to innovate successfully, the development of systems allowing the relation of economic potential of new technologies become important. However, given the fact that a host of manufacturing and service industries rely on adapting/adopting ideas and products developed elsewhere, what is even more important is the ability of these firms to translate innovations into new products and services and the timely and widespread diffusion of technology.

The mechanism of diffusion is much more than just propagation of technology from the source to the user. It involves a constant interaction between the sender and the receiver and a transformation of the knowledge and techniques involved during the adoption phase.

In such circumstances two points are important. Firstly, since most of the economic benefits of new technology are realized when it is diffused widely, a policy which facilitates this transmission is instrumental in increasing the social benefits of the innovation. Secondly, the adoption of new technology or sophisticated equipment and products involves certain transformations. These transformations presuppose a capacity for absorption. Some research capability is. thus necessary in order to understand and assimilate technology developed elsewhere.

Participatory Technology Development

In the original context, appropriate technology was viewed as the development and subsequent transfer of appropriate equipment along with the skills needed to use, it. The analysis of problems identification of needs and possible solutions, and any resulting technology development were carried out in consultation with the end-users or beneficiaries, but decisions about which technologies and skills were needed were usually taken by outsiders — technical specialists — who were often inclined, not always though to 'technology development' rather than 'technology for development'. Despite a theoretical commitment to recognizing both the 'software' and 'hardware' aspects of technology, the transfer of equipment dominated the processes and formed the basis of the criteria by which success was measured. The social and managerial aspects of the equipment use were often not considered leading to end-use problems. A case in point is a certain village in the country where a bio-gas plant was installed as a solution to a 'energy consumption and use' problem. What was overlooked was local customs and practices did not generate enough dung to run the equipment.

Technology development requires the involvement of certain interest groups. The basic questions that arise are: who participates, whose interests are included and who are the beneficiaries of strengthening technological development. Thus the original concept of 'appropriate technology' gave way to 'participatory technology development' .

Participatory Technology Development tends to 'humanize' technical change in a way which enables those at the receiving end, particularly the marginalized and vulnerable to manage and control their own processes of change. While in the short term the objective of the community might be to engineer a particular change or to develop a particular technology in the long term these users would develop their own processes to manage the change and their associated social and political structures thus challenging the environment which keeps them in the marginalized and vulnerable position.

Environment as Related to Industry

Mounting environmental pressures have made it increasingly clear that development policy formulation can no longer be dissociated from environmental concerns. Both industry and environment policy-makers must take into account the multiple interactions between developmental activities including industry and the environment; because of its place at the heart of economic and scientific development, industry's relations with the environment go far beyond the mere impact of enterprises on their immediate environment or on the resources they require. In particular, the development of industry-environment relations is increasingly tied-up with the rapid progress of science and technology.

Over the years, scientific work has established that our activities cause abrupt and unprecedented modifications in the planetary support system. These signals are now transforming the general ideas of the future capacity of the planet to sustain the human life of reasonable quality, from a blissful state to a more realistic but a sobering state of uncertainty.

How does it function? To what extent are the changes irreversible or dangerous? What are their effects and on what time scales? Can they be adapted and if so, how? This mandate pre-supposes that whatever man can damage or alter, he can also repair or make good. In other words, man, to an extent, is capable of managing the earth system to his own advantage.

To deal with these and perhaps many more such basic questions, it is obvious that intensive cooperation may be required between scientists, technologists, engineers and the body politic. This joint action can be successful only when the public at large is involved. To achieve sustainable development, people have to reassess their role and purpose on the globe — their priorities and their relation to those already in distress and to those on the brink of disaster unless redical changes in economics, administration and international relations take place. These awesome challenges cannot be undertaken by science and technology acting in isolation. People of every social status will be drawn into the process of renegotiating the character of sustainable development and the role of science and technology within it. To avoid a future in which every individual is enchained by rigid codes of conduct in a desperate attempt to save the earth, science and technology must play its urgent role. For this it must be both liberating and listening flexible and adaptable, humble yet visionary.

In his epoch-making work, 'Mankind and Mother Earth', historian Arnold Toynbee has contemplated an inquiry on humanity. Humanity can recreate and restore; it can also be both good and evil. Humans have both rational mind and emotional hearts. They have a conscience and are capable of reflective judgement. However, the clash of materialistic goals and spiritual qualities have always been quite profound yet unsolvable. As Toynbee continues,

> 'It looks as though man will not be able to save himself from the nemesis of his demonic material power and greed unless he allows himself to undertake a change of heart that will move him to abandon his present objective and espouse the contrary ideal.'

The ideal is the realization that a gift of life brings with it a responsibility to maintain life on earth in all its diversity and majesty; the recognition that coexistence is an essential counterpart to successful competition and spiritual advancement. It is also the effort of fairness and respect to all forces on earth that amount to creation and evolution. The concepts of sacrifice and self-interest become enveloped in the principles of continuance and companionship. This is the essence of sustainable development.

We are in the midst of a tremendous upheaval in the technological and economic scenario brought about, inter alia, by the new economic policies. We simply cannot afford to be static in this setting. It was Jawaharlal Nehru who said, "To be just correct and static in a changed and dynamic world is to be left behind despite all one's correctness." Under such circumstances, I felt it prudent that we set our directions for the future and charter our course suitably for the next few years. A Perspective Planning Group was formed with eminent engineers on the panel. The recommendations of the group will serve the members, the profession and the nation in a much wider and deeper perspective.

Moving into uncharted directions, problems are bound to occur. One way is to wish them away and be relieved if and when they disappear. Another way is to recognize the problem as a challenge and convert it into an opportunity, in which an initial adversary can become an auxiliary and things seemingly against can turn out to be for the furtherance of the cause. My efforts will be in the second direction and I count on the well-intentioned support of my colleagues in the Council and the membership at large.

Shri P M Chacko — A Brief Profile

Shri P M Chacko — a Profile Shri P M Chacko, B Sc, B Sc (Engg), FIE (b February 18, 1929), a distinguished mechanical engineer, an acknowledged authority in design manufacture and commissioning of plant and machinery has been elected President of IEI for the session 1994-95.

After a brilliant academic career during which Shri Chacko obtained his B Sc degree from the University of Madras in 1948, and B Sc (Engg) degree from the University of Travancore in 1952. he had his initial training with Tata Iron and Steel Co Ltd, Jamshedpur. Subsequently, he worked for the Madras Port Trust as Plant Engineer when a scheme for mechanical handling of iron ore export was conceived. plans drawn up and implemented.

After a brief stint in M A College of Engineering, Kothamangalam, Kerala, he joined Harrisons & Crosfield Ltd. Cochin. as Engineering Executive in 1963. He was elevated as Chief Engineer in 1972. in charge of the company's engineering operations all over India. becoming the first Indian to occupy that position in this large multinational organization. During this period, the company's operations were so successful that some of the activities of the group companies outside India were offered to be transferred to his charge. His services were also made use of by the parent company through visits to various group organizations in several other countries. In 1978, he set up his own practice and has assisted in the establishment of many industrial units in different parts of India.

He has carried out many challenging duty-specific assignments within India and abroad. These include design and setting up of large distillery plants to manufacture industrial and potable alcohol; design and manufacture of equipment; installation and commissioning on turnkey basis of crumb rubber factories; design of palm oil extraction units; aquaculture engineering; special equipment like telescopic steel form-work for large hydroelectric projects; impact analysis for hot-stretching and dipping units for tyre industry, etc. He has tie-ups with world leaders in many fields in order to ensure adoption of latest appropriate technologies.

A multi-faceted personality and a keen sports lover, Shri Chacko was a good athelete in his student days and had represented his university in swimming and volleyball. He represented the state of Bihar in volley-ball while at Jamshedpur.

Shri Chacko is an enthusiastic and active Rotarian of over 25 years standing, a Paul Harris Fellow and has been responsible for organizing various social service projects. He has been actively associated with the establishment and running of several schools and colleges in the state of Kerala. He has also served in the management councils of colleges attached to Kerala, Mahatma Gandhi and Calicut Universities.

Shri Chacko is a founder member of the Cochin Stock Exchange Ltd and has also served on its Board of Directors more than one term. A widely travelled man, Shri Chacko has visited many countries on business and as tourist.

Shri Chacko has been closely associated with the Institution for more than two decades having joined it as Associate Member in 1966, transferred to Member in 1972, and Fellow in 1977. As Chairman, he activated the functioning of the Cochin Local Centre of the Institution. As a member of the National Council for 11 years, he guided its affairs in various capacities such as Member of the Finance Committee, Member, Co-Chairman and Chairman of the Bye-law Committee, Chairman of the Mechanical Engineering Division, etc.

Reputed for his perseverance and persistence in carrying out his mission — giving support to the technical triumvirate of engineering science, engineering technology and engineering practice — and characteristically selfless, unobtrusive, unassuming and of generous disposition, Shri Chacko is a many splendoured personality, much loved and respected in the profession. His election has indeed come as a momentous recognition of his distinguished attainments and underscores the Institution's commitment and continuing efforts to assume the highest level of technological excellence and professional competence in serving the nation. It is hoped that under his dynamic leadership, the profession will reach greater heights in fulfilling the nation's aspirations.

Shri N C Vaish
President 1996-97

Presidential Address

On this momentous occasion, my thoughts go back to the great honour done to this Institution by our Respected Prime Minister Late Mrs Indira Gandhi in inaugurating our Golden Jubilee on February 05, 1970, and her Golden Words, I quote,

"Engineering today is not just a single profession but a generic name to a large number of professions. The more specialization there is, the creater the need for seeing matters in the larger perspective. It is not enough if different kinds of engineers get together but engineers must also meet the delegates of other branches of learning. Each engineer must develop within himself the faculties of social understanding and aesthetic judgement."

And my thoughts continue to travel to another momentous occasion, the First Engineering Congress on January 10, 1987, inaugurated by our beloved Prime Minister Late Shri Rajiv Gandhi, and his thought-provoking words of wisdom, I quote,

"Better technology alone should ensure a better future for the country's masses and the Institution of Engineers, a pioneering body, should address itself to this task. The Institution should pay greater attention to time-bound targets, cost efficiency, quality consciousness, managerial improvement and environmental awareness."

How relevant and true these statements are even today.

The inspirational address and honour bestowed on us by Your Excellency Rashtrapatiji last

December on our Institution's 75th Anniversary, and at the commencement of the Platinum Jubilee year at Calcutta, still rever berates fresh in our minds.

As the eventful year of multi-divisional multi-discipline professional and technical activities at National and International levels culminates into the present Engineering Congress, we again seek Your Excellency's blessings and directions for our continued endeavours towards better quality of life for our people and dedicated service to the cause of Nation.

Seventy-five indeed is a distinguished age with an aura of worth and achievement, and a memory of battles won an glories attained. Individully, at 75, one could feel that its time to slow down a bit, to use and enjoy the things acquired: 'Knowledge, friendship, possessions'. However for organisations like IEI the 75th year is a time to pause and take stock, to look at the road it has travelled and the mileposts it has passed. It is also an opportunity to consolidate the past treasures and perhaps to marvel at our philosophy, ideals, and the leadership in the National and International perspectives. And it is also a time for viewing the present. Where we are today, what we are doing, and are we heading in good direction? And, of course, the special Anniversary is a time for looking forward to tomorrow, for setting new goals, facing new challenges in realisation of our dreams into real achievements.

One advantage that an organisation like IEI has over individuals, is that it is really ageless, in spite of the number of years of existence it celebrates. It can renew itself over and over again, changing to fit the times and the needs of times. It can reach, it can grow, it can serve for a hundred or a thousand years, for as long as it is a productive force.

THE GLORY OF YESTER-YEARS

Journeying back in a time machine, into the distant past, one can marvel a the Foresight — the Initiative — the Action — the Anticipation — the Excitement — the Accomplishments — the Pride — the Satisfaction. In that order, I take pleasure in presenting before you some of the chronological events of annals of IEI.

CHRONOLOGICAL HIGHLIGHTS

1914-18 — The years of planning and foresight by powers that be;

1918-19 — The tremendous initiative by Sir Thomas Holland, the President of Indian Industrial Commission. Inception of 'The Indian Society of Engineers' — transformed to The Institution of Engineers (India);

1920 — Incorporation of The Institution of Engineers (India);

1921 — Inauguration of IEI by the Lord Chelmsford, the Viceroy and Governor General of India with Shri Rajendra Nath Mookerjee as the first President;

1928-31 — Introduction of Associate Members and Students examinations;

1935 — Grant of Royal Charter by His Majesty the King George V endowing the Institution with distinctive responsibility to promote the general advancement of Engineering services and their application in India;

1954 — Transformation into a real multi-disciplinery professional body from the confirnement of 4 basic Sections of Civil, Mechanical, Electrical and General Engineering; progressively growing into all the 15 divisions of Engineering today;

1968 — Inauguration of own multi-storied Headquarters building at Calcutta by the President of India Dr Zakir Husain;

1970 — Golden Jubilee — Inaugurated by the erstwhile Prime Minister Smt Indira

Gandhi;

1983 — Triennial International Conference of World Energy Congress—Inaugurated by the erstwhile Prime Minister Smt Indira Gandhi;

1983-85 — Three Forums, namely, Water Management Forum (WMF), Rural Development Forum (RDF), and National Design and Research Forum (NDRF) were founded with a view to provide a platform for engineers. technologists and scientists to identify with the national problems in the areas of water management, appropriate engineering design based on indigenous research and development as well as to promote rural economy through absorption of fruits of indigenous research and development under the aegis of these bodies. Engineering Staff College of India (ESCI) another peripheral body of IEI was also founded with a view to provide training to practising engineers in the frontier areas of engineers so as to update their knowledge with the recent developments of science and technology elsewhere;

1987 — First Indian Engineering Congress — Inaugurated by the erstwhile Prime Minister Shri Rajiv Gandhi;

1995 — Platinum Jubilee-Inaugurated by His Excellency Dr Shanker Dayal Sharma, President of India.

INTERNATIONAL LINKAGES

In the international arena, the Institution has been the Founder Member of the World Power Conference, now known as World Energy Council 0NEC) and the Federation of Engineering Institutions of South and Central Asia (FEISCA). Later on, the Institution has joined the World Federation of Engineering Organization (WFEO), World Mining Congress (WMC), Federation Internationale de la Precontrainte (FIP), International Federation of Automatic Control (IFAC), International Institutionfor Production Engineering Research (CIRP), and International Council of Aeronautical Science (ICAA). The Institution also has bilateral relations with as many as fourteen sister societies aborad.

MEMBERSHIP

With a humble beginning of only 138 Members in 1920, the Institution has at present a total number of nearly four lacs as details below:

Corporate	—	68,000
Associate	—	13,000
Non-Corporate	—	2,78,000
Students Chapter	—	42,000
Total:	—	4,01,000

MAJOR ACTIVITIES

Some of the major activities of the Institution include:

Technical Education, Human Resources Development, Dissemination of Technical Knowledge through National and International Discourses, and Technical Publications of highest standard, Technical Inputs in various fields of National Interest and International Importance, Engineering Information Service and Networking, Promoting Scientific Research and Technological Development.

THE CHALLENGES OF TODAY

The glory of the past blends with challenges of the preset and leaves no room for complacence.

Challenge of preserving the heritage and consolidating the gains of phenomenal developments of the 20th century, Challenge to effectively and efficiently accelerate growth, development and built-in quality-assurance in all spheres, including quality of human life. Challenge to coexist in a highly competitive and demanding world. Challenge to pave the way for sustainable development. Challenge to safely and optimally steer our common world into the next millennium. Let's have a look at the present scenario, to ponder and choose our priorities and actions.

LIBERALISATION, ECONOMIC REFORMS AND RESTRUCTURING

The recent Liberalisation and Deregulation, particularly in areas of foreign investment and technology, foreign exchange, convertability, the reforms of Indian Industrial, Trade, Taxation and Investment policies (domestic as well as foreign investments), privatisation in key sectors like Power, Telecommunication, Electronics, Computers, Minerals, Housing and Infrastructure in general, have built a new atmosphere. The obvious objective of this restructuring process is to enable us to attain distinct technological and competitive edge in the economy, global perspective, and to infuse dynamic thrust to the growth pattern. To us, the engineers, scientists and technologists, new opportunities and new challenges spring up to transform the thought process into realities, and to realise the very objectives that have been envisioned. But then, is the application of liberalised new framework done discreetly and consciously, choosing right priorities for our society, selecting only the most appropriate technology for our country, and optimising use of scarce resources. The answer does not seem to be strictly and wholly in affirmative. Moving from regulations to deregulations with best intentions therefore seem to still necessitate limited re-regulations, essentially to ensure prevention of monopoly and attracting new entrants, to augment transparency in operations and balancing of interests, to optimise limited resources without disturbing ecological balance, to ensure fair and open competition with built-in quality and performance assurance and to guarantee full consumer protection and satisfaction. It is surprising and unfortunate that Engineers in our country still have little or no opportunity in decision-making in such matters. They have rare occasion to contribute inputs on even technical priorities, appropriate technologies and the Rural-socialenvironmental engineering aspects, which must influence all vital national level policy decisions. The Engineering fraternity anxiously awaits for a rightful place in this regard and hopes to get liberalised in the era of liberalisation from the confinement of simple carriers of pre-fixed decisions to the dynamic and useful partners in the decision-making process.

NATIONAL PRIORITIES

Rural-Urban Development

India is World's the 11th largest Industrialised country. On Purchasing Power Parity basis, Indian Economy produced a GDP of little over US$ 1 trillion in 1993 with a growth pattern of 4.5%, ranking the 5th largest in the world. The industrial growth also registers a growth of over 5%. Paradoxically, however, our per capita GDP is lowest in the world. 230 million peoples still live below the poverty line. Out of which 175 million exist in Rural areas. Nation's first priority, therefore, has to be overall and speedy development of rural and urban areas, and in that order. The Government is already seized of the situation. Rural Engineering has to find primary place in our plans and programmes. Appropriate technology must be carefully chosen. The Institution is fully conscious and is activating its Rural Development Forum for drawing immediate action plans concerning all aspects of Rural Development, viz. Agricultural Production, Distance Education, Artisan Training, Cottage Industries, Opportunites of Self-employment. Drinking Water, Transportation, Communication, Renewable Energy and Sanitation.

Urban Development requires major infrastructural planning, action and financial input. Self-contained Satellite cities — residential and industrial, Mass Rapid Transport System, Communication and Power Networking call for urgent attention and effective action plan.

ENVIRONMENT PROTECTION AND SUSTAINABLE DEVELOPMENT

With the world hurtling towards the 21st century, mankind unknowingly is heading towards a state of catastrophe. A catastrophe created by destruction of the natural resource base. Land, air and water are undergoing a metamorphosis which is taking us towards calamity. Land erosion, floods and droughts may be ascribed to environmental disturbances. Over-urbanisation, and unmindful industrial growth and power generation are vitiating the air. The latest worry for environmentalists is acid rain, posing a great danger to all life on this planet.

In India, the ecological disbalance has become a cause for worry. These need due consideration:

• 6000 million tonnes of fertile topsoil is eroded annually;

• Flood-prone land has doubled from 20 million to 40 million hectares in a decade. In monetary terms a loss of Rs.1000 crores per annum;

• Thar desert has encroached another 4% of the area of Western Rajasthan and made 76%vulnerable;

• 175 million hectares of agricultural/non-agricultural land have undergone serious environmental degradation;

• World consumption of wood is expected to climb up to 4 million tonnes by 2000 AD resulting in our tropical forests getting completely denuded;

• 70% of available drinking water is being polluted by industrial waste, indiscriminate draining and major dam constructions;

• Thermal power stations, petrochemical complexes, fertiliser factories, vehicular traffic and industrial smoke are creating air pollution which has reached a dangerous level;

• Acid rain has now made its appearance in certain over-industrialised areas in India;

• Radioactive waste from nuclear power plants is yet another threat to the elements;

• Oceans have been affected by land reclamation in swamps, urban waste, oil slicks and industrial effluents;

• Massive deforestation is posing a major threat to wild life habitants and slowing down the rate of plant proliferation.

Three essential facts must be realised in the context of global environment degradation. First, all environment problems do arise unavoidably from economic or industrial activities and daily needs of our human society. Second, unless remedied sooner than later, in fact the soonest, it may be too late to prevent lasting damages which may be irreversible. Third, problems relating to environment cannot be tackled only on a local, regional or even National basis, the response and the remedial actions have to be essentially global.

Nevertheless, we need development. And sustainable development in isolation with echo systems on this planet is unconceivable. We have been hearing of the greenhouse effect and the global warming, and also pleas for preserving our beautiful planet, but we seem to find the human community exposed to the dangers so much as ever. Therefore, need for Environment research and Environment audit is for greater today than ever before. The Institution has been doing its bit. We have exclusive Environment Engineering Division, and we would continue to make our inputs and will be happy to augment efforts of the Government and Non-Government organisations on worldwide basis to facilitate a safe and better environment for humanity to survive and development to sustain.

CONSERVATION

We conceptualise conservation under 3 classifications, viz.:

Protection : i.e., Conservation of natural habitat, and the trees, the soil, the water, the environment, and the whole of planet earth.

Recycling : i.e., Reuse of the used materials by imparting fresh lease of life through appropriate technology.

Austerity : i.e., Most economical and conscious use, whether applied to scarce foreign exchange, or to our life line — the energy. (In fact one unit of energy saved equals almost 3 units of energy generated, due to efficiency factor, transmission and distribution losses.)

Our Institution calls for country-wide major awareness programmes and action plans for conservation of all our natural, industrial and living resources, not only to leave enough for the tomorrow's world but also for a better life of our future generations.

RESOURCES MOBILISATION

Mobilisation and efficient use of resources essentially forms an ingredient of any story of success. Our priority areas of resources mobilisation are identified as follows:

Human Resources

Our findings match with the extensive National Survey conducted by the Confederation of Indian Industries (CII) to reveal the acute scarcity in the skilled technicians segment of manpower requirement of the Indian Industry, and our Institution has a vital role to play to help bridge this gap through series of custom-designed programmes in collaboration with the Industry for direct on-the-job training and specialisation. Several centres of our Institution all over the country have already planned to create training facilities in electronics, computers, telecommunications, instrumentation, quality assurance and manufacturing technologies. I take this opportunity to call upon our large number of technician members to keep in touch and actively participate in these programmes.

Energy Resources

The renewable sources of Energy e.g., solar, wind, tidal, geothermal, biomass and small hydro power will playa vital role in the 21st century which is now round the corner. Added to this is the astronomical potential of the nuclear energy which will be the prime source to meet Energy needs for tomorrow's world. The Institution of Engineers (India) strongly pleads for all out efforts towards viably and commercially harnessing these vital resources of energy, and offers Its full involvement and services in whatever manner and capacity required to all the Government and Non-Government organisations. The Institution of Engineers (India) is already actively involved with the World Energy Council and is making significant inputs in all energy-related policy matters on International Level particularly for a mutually beneficial Developing-Developed countries relationship and Regional Cooperations. We are honoured to have an important place on WEC's International Programme Committee, on which the Institution is represented by our retiring President Shri PM Chacko.

Materials Resources

There are two aspects to it viz. better utilisation or minimising wastage, and new substitute — materials for better performance and cost effectiveness. The concept is applicable uniformly to all areas of engineering and industrial activities, and calls for continuing process of development and innovation. The present-day global competitive market forces make it inevitable. We at the Institution would like more effective interaction and deeper involvement in this area with the finest research labs and R&D centres in the country under CSIR, DRDO, various industrial R&D centres, and also the R&D faculties of National Technical Institutes.

Plant Resources

The average capacity utilisation and plant efficiency of Indian Industry today do not register more than 60%. To sustain the emerging global economy where market forces, rather than artificial protections, are dominant introduction of Hi-tech and state-of-the-art methods of industrial production replacement of obsolence with modernisation, and privatisation have become urgently necessary. Certain effective steps have been taken by the Government. A lot more remains to be done. We invite the Government and the Industry at large to take full benefit of the vast expertise and resources available with the Institution — through over members and our dedicated peripheral bodies like ESCI and NDRF.

QUEST FOR EXCELLENCE

In the new world order, and the keenest global competition, the law of survival of the fittest prevails. Quest for excellence becomes the pass-word in all aspects of our industrial, commercial, technical and even social activities. Total Quality Management systems, whichever way characterised — whether as Taguchi system or ISO:9000 TQM series, have assumed new relevance. Our own peripheral body, the Engineering Staff College of India at Hyderabad, as also a large number of State and Local Centres all over the country have taken up the task of conducting extensive programmes on Total Quality Management with heartening response from Industrial, Commercial and Technical organisations.

OUR COMMITMENTS

Our efforts continue, in all directions, individually and collectively. We stand committed to the Art and Science of creativity. Creativity for development of Human and National resources, creativity for qualitative, quantitative and competitive generation of National Wealth. Creativity for sustainable development without disregarding environment. Creativity for a brighter and better tomorrow blessed with high quality of life. Committed we are to prepare the Nation and our People to usher into the 21st century with pride, perfection and confidence. And committed indeed we are, deeply to the odds of our professional ethics, human values, and philosophy of excellence in whatever we say, do or think. On this momentous day, we at the Institution of Engineers (India), re-dedicate our knowledge and expertise to the cause of our National and International community

Shri N C Vaish — a Brief Profile

Shri Naresh C Vaish, BSc, BE(Mech), FIE, P Eng (I), Managing Partner of Kanpur Metal Products, Kanpur, a distinguished mechanical engineer, an engineer-industrialist and also the Chairman of the Mechanical Engineering Division, has unanimously been elected President of IEI for the session1995-96.He will assume the President's office at the next Annual General Meeting of Corporate Members of IEI, to be held at Jaipur on December 23, 1995.

Having obtained his first-class degree in mechanical engineering from the Birla College of Engineering, Pilani (Rajasthan) in the year 1963, Shri Naresh C Vaish (born on December 13, 1942) had his initial training with Hindustan Motors, Hooghly (West Bengal); Roadways Central Workshop, Kanpur; and Singh Engineering Works, Kanpur (Uttar Pradesh). He subsequently joined Emel Industries as Technical and Managing Partner and served there for more than a year. Shri Vaish had also undergone extensive training with a number of multinational companies including Theo Goldschmidt AG, the then West Germany; Rekofa Wenzel GmbH, the erstwhile West Germany/USA; and ICI Ltd, UK.

He then founded Kanpur Metal Products, an engineering unit for designing and manufacturing speciality bearings for turbines and turbo machinery, an import substitution item, in the year 1965, catering to domestic as well as global needs.

During his long professional career, he was responsible for setting up several engineering units, namely, Synthetic Foams Ltd (in collaboration with ICI Ltd, UK); Sintered Graphites Pvt Ltd (an Indo-German Company); and Bharat Consultants Pvt Ltd.

Shri Vaish has been closely associated with IEI for nearly three decades, having joined it as an Assoicate Member in 1969,was transferred to Member in 1972and finally became Fellow in 1980. He was instrumental in organizing several career-enrichment programmes under the aegis of the Kanpur Local Centre of IEI and displayed his dynamic leadership quality. As a member of the National Council of IEI for nearly ten years, he guided its affairs in various capacities such as Member, Finance Committee; and Chairman, Mechanical Engineering Division.

Shri Vaish is also a Member of the National Council of Mechanical Engineering Division of the Bureau of Indian Standards; Member of Marchant Chamber, Uttar Pradesh; Member of Indian Industry Association; Trustee of various public charitable trusts, engaged in educational and research activities, as well as on the Senate of Indian Institute of Technology, Kanpur.

Shri Vaish is an eloquent speaker and good writer too. He has to his credit a number of papers on design, performance optimization and failure-analysis of high-speed profiled bearings, published in reputed technical publications.

Shri Vaish has widely travelled throughout the world. He had also led a five-member delegation to the USA under group study programme. Reputed for his perseverance and persistence in carrying out his mission — giving support to the technical triumvirate of engineering science, engineering technology and engineering practice — and characteristically selfless, unobtrusive, unassuming and of generous disposition, Shri Vaish is a many-splendoured personality, much loved and respected in the profession. His election has indeed come as a momentous recognition of his distinguished attainments and underscores the Institution's commitment and continuing efforts to assume the highest level of technological excellence and professional competence in serving the nation. It is hoped that under his dynamic leadership, the profession will reach greater heights in fulfilling the nation's aspirations.

Sri K V Chaubal

President 1997-98

Presidential Address

The Institution having celebrated Platinum Jubilee and approaching its centenary, I feel it appropriate to outline a few of the priority programmes I intend to pursue in the coming year.

EXAMINATIONS

The most noteworthy role of national service which the Institution has been playing since 1928 and of which the members can take pride, is that of coaching and conducting examinations. It enables boys and girls, for whom formal college education is beyond reach and/or beyond means, to acquire engineering qualifications; in many cases even while working. It is perhaps the most inexpensive route to the status of a Chartered Engineer. Beginning with 5 candidates in 1928, in 1997 some 1,00,000 candidates are expected to seek admission to the examinations. Considering the past trends, some 3000 will fully clear all the subjects, a magnitude perhaps comparable or even larger than some of the Universities. If these 3000 students were to take formal College education for engineering degree, their expenditure and additional burden to the exchequer would be about Rs.40 Crore as compared to about 3 Crore for Institution's coaching and examinations. This saving to the candidates and the nation (Rs.37 Crore) is made up of general funds and infrastructure of the Institution and more so by voluntary services rendered by its members. One can thus realize the Institution's contribution to the national economy and the benefit to the society at large.

TECHNICAL LITERACY IN RURAL INDIA

With the establishment of Engineering Colleges and Polytechnics in many of the towns, there is need for the Institution to expand its coaching and examination facilities to promote technical literacy in rural India.

DIPLOMA LEVEL EXAMINATIONS

This would in turn demand creation of an additional Diploma level examination appropriate to rural circumstances and requirements. Such a need is also felt even in the industrial sector as equipping the shop-floor worker with basic theory would go a long way in not only improving the quality of the product and productivity but also workmen's skills and capabilities.

SKY CLASS-ROOMS

In order to make the coaching classes more effective, upgrade the quality and take them to rural and remote areas, the Institution with the cooperation of the Indira Gandhi National Open University would use the University's Satellite facilities for what may be called "Sky Class-Rooms" spread all over the country. I am happy that this project is in an advanced stage and regular telecasts will commence shortly.

In the interest of the prosperity of the country, disparities must give way to even distribution of opportunities; and in this context the Institution's penetration beyond urban areas would be welcome to all.

POST-GRADUATE LEVEL COURSES

To enlarge the scope of its role in technical education, the Institution would also consider the introduction of post-graduate level courses so as to equip the engineer to face the newer demands and challenges in his profession.

OPEN UNIVERSITY

The Institution, with its unmatched long and vast experience and infrastructure facilities all over the country, is the most suited organization to convert its coaching and examination facilities into an Open University. An expert group is already working to make this a reality in the near future.

DIPLOMA ENGINEERS

When the Diploma level examinations take a practical shape, I would advocate that the Institution find ways to bring into its fold the vast number of diploma engineers and enable them to play an effective role and enjoy appropriate status in the Institution.

NEW CENTRES

The Institution has 92 Centres spread all over the country but these are largely situated in State Capitals or headquarters of large districts. There are, however, elsewhere pockets of concentration of engineers either working for Government projects or industries. The Institution will attempt to identify such pockets to facilitate formation of new Centres, if need be, by making suitable changes in the Bye-Laws, so as to service the professional needs of these engineers more effectively.

YOUNG MEMBERS' STATUS

Amendments hove already been proposed to the Bye-Laws to enable associates to effectively contribute to the working of Centres and this exercise will be completed shortly.

MANAGEMENT

Steps will also be initiated during the year to streamline membership and financial procedures, linking large Centres to facilitate access to data bank at the headquarters, upgrading publications, making the administration at headquarters and Centres more responsive and better prepared so as to upgrade services to the members.

JAMMU AND KASHMIR

The disturbed conditions in the Kashmir valley have led to slowing down of the Institution's activities and suspension of the examination centre in Kashmir. The Institution has already initiated steps to re-activate its role and to re-open the examination centre as soon as possible.

FINANCIAL RELIEF

If necessary, the Institution should consider offering some financial relief to these young unfortunate candidates.

PLACEMENT SERVICE

I would also advocate that the Institution, as a special case, offers a placement service to the young unemployed members of the Institution from the State seeking employment in industries located elsewhere in the country.

I do hope that these endeavours of the Institution would be supported and a helping hand extended by the Union and State Governments.

ASSISTANCE AND BENEVOLENT FUND

For boys and girls, especially in rural areas, who can ill afford to pay even the examination fees, the creation of a special assistance fund would be appropriate end timely.

It will be my endeavour to create a Trust Fund primarily to assist the needy and competent boys and girls having inadequate financial means. A part of this fund would be earmarked as a benevolent fund for the benefit of the members of the Institution who are in distress. I would urge the members, the governments, the industrialists and philanthropists to donate generously to this fund.

I am aware and conscious that I may not measure up to the valuable contributions of the members, the Council Members. and the Past Presidents to the growth, attainments and raising of the status of the Institution, I can only assure you that I would dedicate myself, with humility, simplicity, transparency and down to earth approach to the tasks ahead.

THE INSTITUTION OF ENGINEERS (INDIA)

1919 Formation of 'Indian Society of Engineers.' The name of the Society was changed to 'The Institution of Engineers (India), and registered in Madras. The registered office was moved to Calcutta.

1920 The Institution was incorporated under the Indian Companies Act of 1913.

1921 Formal inauguration by the Viceroy with Sir Rajendra Nath Mookerjee as the President.

1923 The Institution became the Indian National Committee of International Electrotechnical Commission, 1923.

1923 Central Library established and later converted into Sir R N Mookerjee Central Engineering Information Service Centre in 1992. All Centres have libraries widely used by students and members as well.

1924 Rules and Syllabi for examinations drawn up.

1927 First list of accredited qualifications.

1928 First examination for Corporate Membership—5 candidates appeared. Since 1944 the examinations are held twice in a year.

1935 Grant of Charter which entitled the Corporate Members to inscribe 'Chartered Engineer (India),' after their names. The objects of the Institution as set out in the Charter are briefly to promote and advance science of engineering in all its branches and diffusion among its members the message of inter-dependence of all matters affecting engineering. Thus, enjoined, the Institution is concerned with the progress of engineering knowledge which recognizes no specific frontier. The Institution has been acting as a qualifying body conferring membership in various disciplines and maintaining the highest standard of professional conduct.

1945 Appointment of Indian Standards Institution (ISI) Committee by the Council of the Institution, submission of its report in 1946 and approval of the report and formation of ISI by Government of India.

1945 Silver Jubilee inaugurated by the Viceroy.

1954 Transformation into a real multi-disciplinary professional body, progressively growing into 15 Divisions of Engineering.

1959 His Excellency Dr Rajendra Prasad, the President of India inaugurated the new building of Central India Centre in the presence of S/Shri C D Deshmukh, Lal Bahadur Shastri, K C Reddy etc.

1968 His Excellency Dr Zakir Hussain, the President of India, opened Headquarters building at Calcutta.

1970 Golden Jubilee inaugurated by the Prime Minister Smt Indira Gandhi.

1971 Class of Corporate Membership—Fellow (F.I.E.) introduced.

1980 Diamond Jubilee inaugurated by the Vice-Presidentof India His Excellency M Hidayatulla. Mother Teresa conferred with the Honorary Life Fellowship.

1981 Establishment of Engineering Staff College at Hyderabad for continuing education programmes for practicing engineers.

1983 Hosted Triennial International Congress of World Energy Conference inaugurated by the Prime Minister Smt Indira Gandhi.

1983 Formation of Water Management Forum, 86 Rural Development Forum, National Design & Research Forum.

1987 First Engineering Congress—inaugurated by the Prime Minister Shri Rajiv Gandhi.

1995 Platinum Jubilee—inaugurated by His Excellency Dr Shenker Dayal Sharma, President of India.

1996 The Prime Minister Shri H D Deve Gowda conferred with Honorary Fellowship at a special function in Bangalore.

INTERNATIONAL CONNECTIONS

The Institution is the founder member of the World Power Conference established in 1924, and now known as World Energy Council (WEC), and is active member of World Mining Congress (WMC), World Federation of Engineering Organizations (WFEO), International Federation of Prestressed Concrete (FIP), Commonwealth Engineers' Council (CEC), and again a founder member of Federation of Engineering Institution of South and Central Asia (FEISCA).

The Institution has bilateral relations with sister societies abroad — Hungary, USA, USSR, Germany, Bulgaria, China, Yugoslavia, Poland, Czechoslovakia, U.K., Nepal, Canada, etc.

GROWTH OVER THE YEARS

	1920	1940	1960	1980	1996
Corporate Members	138	1.190	7,603	41149	67625 (as on 30.6.96)
Non-Corporate Members	Nil	282	19344	85226	302194
Candidates for examination	5 (1928)	45	8636	35672	98034
Examination Centres	1 (1928)	5	19	50	46
State and Local Centres	5	8	18	61	92
Buildings (Hq & Centres)	-	-	7	39	47
PUBLICATIONS					
Bulletin (issues in a year)	4	-	12	12	16 (IEINews-12 INR 4)
Journals	1	4	14	54	40
Papers	36	45	121	352	298

STUDENTS

44 Technician Chapters, 92 Engineering College Students Chapters, 88 Polytechnic Students Chapters are functioning, serving over 2,87,596 technicians / students.

OTHER PROGRAMME & ACTIVITIES

The technical activities of the Institution are mainly carried out through fifteen Engineering Division Boards pertaining to Aerospace, Agricultural, Architectural, Chemical, Civil, Computer, Electrical, Electronics & Telecommunication, Environmental, Marine, Mechanical, Metallurgy & Material Science, Mining, Production and Textile Engineering.

CONGRESS & CONVENTIONS

The Institution holds every year Annual Convention of each Division as also the Engineering Congress. These events are open to the entire Engineering fraternity.

MANAGEMENT

The President is elected by the Council with a tenure of one session, could be re-elected for one more session.

The Council represents members of all the divisions, State Centre Chairmen, large Local Centre Chairmen, and one representative from each State Centre and four eminent engineering personalities are co-opted every year.

The Secretary & Director General is responsible for the administration of the Institution.

MEMBERSHIP

The membership comprises three categories:

Honorary	:	Honorary Fellows, Honorary Life Fellows.
Corporate	:	Fellows, Members, Associate Members.
Non Corporate	:	Associates, Affiliates, Senior Technicians, Technicians, Institutional and Donor Members.

Corporate members are entitled to describe themselves as Chartered Engineers. Fellows and Members, subject to the individual approval of the Council, can also describe themselves as 'Professional Engineers.'

A BRIEF LIFE SKETCH

BHARATRATNA Dr Sir M Visvesvaraya

Dr. Sir M. Visvesvaraya's personality and his public services evoke love, respect and admiration in grateful people who bless him for what he was and what he has done and the manner of it. He is a world figure, a most eminent Indian and undoubtedly the greatest Mysorean who ever lived. A review of his life and work, however brief and inadequate to render him full justice, is still a source of enlightenment and inspiration. This brief sketch will attempt a running commentary, as it were, on his life. With no pretence to comprehensiveness.

Sir Mokshagundam Visvesvaraya, K.C.I.E., D.Sc., LL.D., M I.C.E., was born in the small village of Muddenahalli in the Kolar District of Mysore State on 15th September, 1861. His father, Shri Srinivasa Sastri, was a scholar who devoted most of his time to the study of Hindu scriptures religious, practices and in pilgrimages to the places in India holy to the Hindus. His mother, Shrimathi Venkachamma, was a pious lady strong in character and capacity. Both the parents exercised a healthy influence on young Visvesvaraya and helped to mould his character. His maternal uncle, Shri. H. Ramaiah, dynamic personality, played the role as Godfather to him and gave a decisive turn to his career. One occasion, Visvesvaraya seems to have absented himself from school for nearly two months. On coming to know of it, Ramaiah gently rebuked his sister by asking if she intended that her son should become a village shepherd! That did it. Next morning Visvesvaraya was back at school. Another early influence in his life was Shri Nadhamuni Naidu, a teacher in the school in Chickballapur, who sensed the potentialities of the lad and inspired him with love of reading good books and installed in him love of regularity and other good manners.

Srinivasa Sastri died when his son was only fifteen years old. Though rich in scholarship and piety, he was poor in material goods. Visvesvaraya owed much to his maternal uncle, Ramiah, in his further education and subsequent career. In 1875, he moved to Bangalore for his higher studies and joined first the Wesleyan Mission High school and subsequently for the Central College. Life was hard and uncomfortable. To meet his expenses, he undertook private tuition in a Coorgi family. He slept in their house, woke up early and taught the children and then went to his uncle's place for food and then went to College. What he lacked in material comforts he made up by his courage and determination. He was a brilliant student and attracted the special attention of the British Principal, Mr. Charles Waters, who took a great interest in him and his progress in College and admired his keen sense of duty and punctuality and presented him with a copy of Webster's Dictionary, which has been his constant companion since then. He had great respect and affection for the Principal and called on him, years after, in London. Waters was deeply touched and bequeathed him Gold Cuff-links to Visvesvaraya and commissioned Mrs. Waters to present them to him personally. Visvesvaraya cherished them with love and respect.

Visvesvaraya passed his B.A. examination in 1880 with distinction, as anticipated by Principal Waters, who certified that his pupil bore the "very highest character", was a "Capital mathematician and a very good English scholar", and secured for him a scholarship to enable him to study engineering in the College of Science, Poona. He joined the College in 1881 and came out first among the successful candidates in the examination in 1883. His Professors took keen interest in him and helped him to complete his College course in two and a half years instead of the usual three. He enjoyed his life at the College.

In later years, at the invitation of the Principal, he gave a lecture a week at the College on irrigation engineering. He was, much later, a member of a Committee appointed by the Bombay Government to reorganise the courses of study in the College.

His brilliant success in the examination brought him the James Berkeley Prize and the appointment of Assistant Engineer in the Bombay Public Works Department, a post guaranteed to the first among the successful candidates, and he entered on the first rung of his official career in February 1884, when he was twenty-three years of age. He rose to the position of Superintending Engineer in 1908, the highest post open to Indians at the time, and during this period, naturally, he worked in several places planning and executing irrigation works.

In the early days of his career as Assistant Engineer, he incurred the displeasure of his superior, the Executive Engineer. On account of heavy monsoon rains, he proposed to postpone an engineering project he was executing at the time, as it would involve wasteful expenditure. The Executive Engineer thought that he was lacking in energy and obedience to orders! Thus, challenged, he completed the work in time, where upon the same Executive Engineer cancelled his adverse remarks and counselled Visvesvaraya to appear for a practical examination much before the usual time required for the purpose. Visvesvaraya's diffidence was overruled by the Executive Engineer, who admonished him not to develop a defeatist mentality. Thus encouraged, he appeared for the examination, came out successful and was soon promoted to the second grade and soon after to the first grade. Thus, within twenty months of entering the service he rose to the first grade, which was remarkable achievement.

At his request, he was posted to Poono and given charge of civil engineering works like buildings and roads, which gave him new experience. In 1893 he was invited to go to Sukkur, in Sind, to execute the water supply and drainage scheme for that city. He was told that the climate of Sukkur was not exactly salubrious compared to Poona, but he would have the compensatory advantage of being his own master. The work would be both interesting and instructive and might enable him to make a mark for himself. He accepted the invitation and completed his mission in a comparatively short period, and was complemented by Lord Sandhurst, the Governor of Bombay, as the "most able engineer" the project could have had.

After successfully executing several other assignments in other parts in the then Bombay State, Visvesvaraya was reposted in 1899 to Poona as Executive Engineer, Poona Irrigation District. This was a turning-point in his career. To the management of things, he added the management of men. His first challenge the irrigation in each village within blocks of specified units and in selected soils and situations, so that there would be a sort of triennial crop rotation in each block, with maximum utilisation of water.

The Government of Bombay entrusted Visvesvaraya with the responsibility of introducing the scheme. He encountered opposition from the revenue officials, European and Indian, from the District Collector down to the village Munsiff. He then secured the appointment of a small committee of a Deputy Collector and an engineer to promote the scheme. They also faced opposition from the officials and the rural population. He asked the Committee to gather evidence of the nature of opposition, and when that was ready, he presented it to the Government. The letter promptly instructed thier, obstructive officials to co-operate. He met the opposition of the cultivators by persuading some of them to adopt the scheme as an experiment. When its success was demonstrated the scheme was generally adopted. In 1908, the spokesman of the Bombay Government said the Bombay Legislative council that the 'Block System Irrigation' was a "complete success" and its development was "entirely to the genious of Sir M. Visvesvaraya certainly one of the ablest officers, Europeonor Indian, of the Public Works Department." The Block System of irrigation, has found a place in the standard workman irrigation and among them R.B. Buckley's irrigation works in India, published in London.

Another invention of Visvesvaraya is the Automatic Sluice Gates. Poona Received its water supply from a lake. The weir contained insufficient water in other seasons. Visvesvaraya devised and installed above the weir automatic gates which stored water well above the crest of the weir and the high flood level, but when that level was reached, automatically opened and let surplus water escape. When the water fell below level, the gates closed and held the Water. Visvesvaraya took out a patent for his invention, but declined to collect royalty from the

Government as the work was carried out under his supervision when he was a Government servant. The gates were fitted in 1901-3, and were working satisfactorily when he saw them forty-five years later. The system of automatic gates were subsequently adopted in other irrigation works in Gwalior and in Krishnarajasagar and has been described in Buckley's Irrigation works in India.

In 1904, Visvesvaraya was elected a member of the Institute of Civil Engineers, London, and attended the Irrigation Conference, in Simla, and submitted four papers. In the same year, he was appointed Sanintary Engineer to the Bombay Government, the first Indian to hold that office. In 1908, at the request of Lord Morley, the Secretary of State for India, he was deputed to Aden to prepare schemes at the instance of Gopal Krishna Gokhale, the then President of the Municipality.

In 1908, Visvesvaraya resigned from the service of the Bombay Government though he was not due to retire and was not entitled to a pension, On account of the special duties assigned to him, he had superseded several of his seniors, which caused some discontent among them. Because of this and also because of the political considerations of the day precluded the appointment of an Indian as Chief Engineer to which he was qualified by ability and service, he resigned. All the same, the Government of Bombay granted him a pension in view of the "exceptionally meritorious services" he had rendered, while regretting his resignation.

During his stay of nearly fourteen years in Poona, in the Bombay Government service, Visvesvaraya had welcomed opportunities of coming in close contact with the political social and economic giants of the day in that city of learning and history, such as Mahadev Govind Ranade, Gopal Krishna Gokhale, and Bal Gangadhar Tilak. He was Sanitary Engineer to the Poona Municipality when Gokhale was its President. It was at Gokhale's house that he first met V.S. Srinivasa Sastry. After he had left, Gokhale turned to "Sastri and drew attention to Visvesvaraya's correct dress" and added, "he is equally precise in his work and in his engagements. If I had such men to deal with in all my business, I could wish for nothing better". Mahadev. Govind Ranade was the guide, philosopher and friend of the enlightened public in Poona. As a Government servant, he did not take part publicly in politics but he inspired the Liberal school of politics, through the Sarvajanika sabha and its Journal. At his invitation, Visvesvaraya contributed an article which Ranade Looked over and published in the Journal. Ranade was the father of Indian economics, a subject dear to Visvesvaraya. He was also a pioneer in social reform upto a point. Caste prejudice were still strong, Ranade and some others ventured to take up tea with some Christians and were severely criticised by Tilak and his papers. Visvesvaraya who had visited Japan in 1898, had no such inhibitions.

Because of caste restrictions, social life as understood in more advanced countries was lacking in Poona. Ranade was among the pioneers who had proposed to start a club in Poona, but some of his best friends thought that it was a mean trick to dishonour caste rules and prohibitions. In some clubs, members met, discussed, read and resolved, but would not eat together. Visvesvaraya felt as early as in 1891 that another and more determined effort should be made to start a modern club and approached Ranade for his blessings and for his support in securing the historic building, Hira Baug, for it. Ranade was some what sceptical; he remarked that Indians spent their evenings in Pansupari parties only and not clubs. But Visvesvaraya persisted and won the support of Ranade and several others and launched the Hira Baug Club in 1891. His heart sank when at the advertised time after the opening ceremony there were only ten present, but was cheered when later the attendance increased to about seventy. He darely commented that in those days people entered a meeting place only after making sure that a worthwhile speaker was already on his legs! Punctuality was foreign to Indians then, as it still is today!

It is interesting especially to Mysoreans to know that the building Hira Baug was the result of the promise which the Peshwa had made to his wife, which he remembered in 1768 when he was fighting against Hyder Ali at Srirangapatnam. He had promised he would build a suitable house with a nice garden for his wife, to which she could retire when he went out on foreign expeditions, and he wrote to his Minister from Srirangapatnam about it. Thus Hira Baug was built.

Ranade and Gokhale were members of the Managing Committee of the club, and Visvesvaraya was one of the Joint Secretaries till his transfer elsewhere in 1894. He was specially invited to preside over the Golden Jubilee of the Club in 1941.

On one occasion, Visvesvaraya was invited to dinner by Ranade in Bombay, and the conversation turned on the progress which he noticed in Japan during his visit to that country. While bidding him good-bye, Ranade sadly remarked that there was one disease from which all India suffered and that was paralysis of effort, which inhibited progress.

Soon after his resignation from the Bombay Government Service, Visvesvaraya decided to spend a couple of years in travel abroad with a view to study developments which might be applied to India. This was his second trip abroad. His first foreign journey was Japan in 1898. He had compiled then a small book of the notes he took of conditions in Japan, but refrained from publishing them because he was then a Government servant. In his second trip abroad, he was able to visit Italy, Sweden, Denmark, Holland, England, Russia, Canada and America and to visit farms and factories, irrigation and drainage works and a great many modern developments in those countries, which widened his own perspective. His experience enabled him to make plans for the economic development of India which he was able to put into operation subsequently.

His plan to spend about two years abroad was interrupted by an urgent invitation which he received on October 29, 1908 from the Government of his Exalted Highness the Nizam of Hyderabad, owing to the floods which caused considerable damage to the city in September, 1908. He agreed to take up the office of Special Consulting Engineer, but only after some months, during which he could finish part of his European tour. When he did not receive a confirmation letter in time, he wrote to cancel his consent but negotiations were resumed.

Visvesvaraya entered his new office on April 14, 1909, and after collecting the necessary materials prepared a scheme to protect the city from floods and another for the drainage of the city. Their implementation was delayed for some years, partly, because of the opposition and the British Engineer of the Madras Government who had commented on the schemes drawn up by the distinguished engineer, Visvesvaraya and recommended that "they should be carried out at once without any talking," that work commenced. At the request of the British resident in Hyderabad State, Visvesvaraya prepared a scheme for Secunderabad Cantonment. He left Hyderabad service in November 1909. He was invited for a second time to Hyderabad in 1922 to report on the progress of the drainage scheme and paid some half a dozen visits to the city. In 1930 he was invited to Hyderabad again to prepare a comprehensive scheme for the improvement of the city.

On his return from his foreign tour on April 10, 1909, Visvesvaraya saw a telegram from the then Dewan of Mysore Mr. V.P. Madhava Rao, inviting him to accept the office of Chief Engineer of Mysore State. He had at that time no intention of joining the Mysore service. In any event he was committed to his assignment as Special Consulting Engineer in Hyderabad. But a couple of months later he was again invited to go to Mysore at the instance of the Late Highness the Maharaja Krishnaraja Wadiyar, who was impressed by his "High qualification and distinguished services" and also influenced by the fact that he was a Mysorean. The Dewan's letter said among other things:

"His Highness is confident that should you accept the offer now made to you, you will find ample scope both for your energy and talents in developing the vast irrigation resources of the land of your birth. His Highness is aware that you attach greater importance to opportunities for rendering public service than to mere official emoluments. Such opportunities will be open to you in Works and projects which have to be carried out in Mysore."

Visvesvaraya had no intention of taking up routine service under any Government. He therefore enquired if there was any assurance that the Mysore government would be interested in initiating large schemes of technical education and industrial development and utilising his services for that purpose. On receiving the assurance, he joined the Mysore service as Chief Engineer on November 15, 1909.

At the very outset of his career as Chief Engineer, he received a list of names of persons to be newly appointed in the Public Works Department whose main Qualifications were that they were relations of high officers or had recommendations from them. He rejected the lot and asked for a fresh list based on merit and qualifications. It was an innovation which evoked some hostility from the disappointed officials which hampered his reformative zeal. For instance, his attempts to introduce the Block system of irrigation under the Marikanive Irrigation Dam, as he had done in Poona, were obstructed not only by the uneducated cultivators but also by the educated and the officials.

In pursuance of the assurance given to him as a condition of his appointment to Mysore service, the Government of Mysore appointed two committees, one on technical education and another for industrial development, which had Visvesvaraya as chairman of both, The Committee on technical education reported on 1912. On the 10th June 1911, the Economic Conference was inaugurated by His Highness in a speech which expressed the plans of Visvesvaraya. "Education is the sovereign remedy for all economic ills", said His Highness and education was therefore given the first place in the general programme placed before the Conference. Economic progress depended on. up-to date tools and skills. "We cannot hope to succeed if we continue to work with antiquated tools and follow old fashioned methods."

In his address to several bodies between 1910 and 1912 when he was the Chief Engineer, Visvesvaraya outlined the plans for Mysore which he had formulated in the light of his comparative studies abroad. He showed by arrays of statistics how and in what respects India and Mysore were behind other countries like Japan, Britain and America, and what efforts, moral and material, were necessary to forge ahead in agriculture and industry, education and administration, planing and execution. In this address to the Mysore Engineers Association on November 14,1920, he stressed the need for engineers to keep abreast of the times by reading, research and conference and follow the examples of the more advanced countries. Though Mysore was blessed with a large number of tanks for irrigation, the use of the water was not economical and scientific. He advocated the example of Italy, where canals were constructed by the Government or Private Companies and the control and distribution of the water was done and undertaken by associations of cultivators who engaged engineers and lawyers. The more the local people looked after the irrigation and other needs the greater would be their productive power and the less their dependence on the government. Mysore needed more railways, more public buildings, town planning and drainage and water supply, eradication of malaria, cleaner and more sanitary upkeep of temples, bathing-ghats and open spaces, quicker means of transportation and a host of other amenities and facilities which had developed in the advanced countries.

There was work for all who would put in a day's honest work. No job was so humble that it should not be done well. He drew pointed attention to the defects of Indians which had grown up with their traditional, environment and climate. He lamented that with Indians the charm of life consisted in ease, apathy and slackness. A keen and competent Frenchman remarked "Slackness is worst curse of the country. At first sight, everybody seems to be taking an active part in some common toil; as a matter of fact, several persons are looking on at the labour of one. As has been remarked, out of five people who seem to be working, one is doing nothing, one is resting, one is looking on and another is helping the previous three. Everyone endeavours to escape the toll of toil." He felt that unless Indians considered slackness a disgrace, there was no hope for them. They must remember that character was more important than cleverness. If he referred to their defects, it was only to stir Indians to greater activity and progress. Destiny was not a passive agent which lay in the lap of the gods but was an active instrument that lay in he hands of men to shape their ends as they willed. India's watchword should be "investigate, educate and organise." Every speech of his was informative and inspiring.

While he was Chief Engineer, he initiated steps for the Mysore Government to build new railway lines and to take over the existing lines which were managed by the Madras and Southern Maratta Railway Company — a British' Company. The later proposal was strongly opposed not only by the British Resident. Undaunted by such strong and influential position, Visvesvaraya persisted in taking the matter to the Secretary of State for India, London and scored success later when he was Dewan.

He took up the question of building a huge reservoir by throwing a dan across the Cauvery river at Kannambadi to provide water for irrigation and electric power. Thanks to his studies of the Asswan dam in Egypt and other experiences, he did not take long to draw up the project to suit local conditions. It's execution, however met with difficulties, both from within and outside the State. Some of the senior Mysore Officials baulked at the large expenditure involved and persuaded the Maharaja to hold up the project to suit local conditions. Disappointed Visvesvaraya took short leave. When questioned by the Maharaja, he admitted that as his schemes were not taken up with enthusiasm and he had only routine work to do he lost interest and therefore wished to resign. Where upon the Maharaja dissuaded him from this step and not only offered to back him up in his development projects but also scrupulously kept his promise. He promptly sanctioned the Kannambadi Reservoir scheme.

But that was only a partial victory. The Madras Government were also interested in the Cauvery Waters for their Mettur dam, and feared that the new dam in Mysore would cut into their needs and necessitate re-designing their dam at Mettur. There was therefore opposition from that quarter. At the intervention of the Government of India, and Lord Hardinge, the Viceroy and Governor General, Mysore, was ultimately permitted to build a smaller dam. But confident of ultimate success Visvesvaraya timed the completion of the dam and the electric installations by July 1, 1915. The Kolar Gold Fields, a British Company, was sceptical and proposed to build their own thermal electric power station. They were surprised and gratified when the timing was kept up.

Dewan of Mysore

In November 1912, Vivesvaraya was invited by His Highness the Maharaja to accept the office of Dewan. He asked to be appointed to the lesser office of a Member of the Government and be placed in charge of the Development Departments concerning the education, industries and the like so that he could give undivided attention to them and not be distracted by general administrative problems. But, at the insistence of the Maharaja, he accepted the Dewanship, and soon welcomed it as it gave him wider opportunities to further the progress of Mysore. His appointment as Dewan was a departure from tradition, for, the office had been held in the past by members of the Civil Service. It caused some surprise and misgivings, particularly among the officials, one of whom was reported to have said that to appoint a "mere engineer" as Dewan was as mad as putting a woodcutter at the helm of the state. But, the Maharaja and the general public thought otherwise, The former had evidently made up his mind to embark on a bold Policy of rapid advancement, educational, economical, industrial, agricultural and others and saw in Visvesvaraya the best instrument for the purpose. The general public saw in him the "coming man" who could deliver the goods as no other could.

When he took the Dewanship, Visvesvaraya took stock of the situation in Mysore and observed that the level of general education and economic competence was low, people lacked initiative, ambition and organisation, and the leaders lacked the power of planning. Only one in sixteen was able to read and write; cultivators were not fully employed and in years of scarcity were without occupation and hope; three fourths of people lived in villages and were dependent on agriculture and had no interest outside their individual households. Land owners were small holders; business was conducted by petty traders and artisans each working more or less for himself and without organisation and co-operation. When all the world was making marvellous progress, the people of India were still pursuing practices two thousand years old and earning a miserable subsistence, ready to die like flies at the first occurrence of famine or prestitence. Relief from such depressing conditions was possible only if the people developed self help and co-operation and welcomed progressive changes with cowage and determination, and promoted education, particularly technical education and industrial development at a rapid rate and followed the example set by Japan and other advanced people. Since nine tenths 'of'! the Indian people lived in Villages, Visvesvaraya drew up a blue print for villages that should be the unit for economic development and should publish essential statistics to measure the progress each year, like an annual budget. If each village showed some little improvement, the collective result would be large. Every village should have a school to educate the children, should subscribe to some newspaper and magazines to keep abreast of the times, should keep a reserve of food grains to last two years as an insurance against famine, should provide a subsidiary occupation to the cultivators, in their off season and show some public improvement every-year;

Visvesvaraya pioneered planned development in India to be undertaken by Government with the enthusiastic co-opertion of people. As Dr. Gilbert Slater said in his book, "Southern India: Its politics and Economic Problems", Visvesvaraya anticipated even the Soviet Government in drawing up the Five Year Plans for the productive progress of India in all fields. Though he gave top priority to education and industrialisation, he stimulated every aspect of life and "hustled" the people as never before. He emphasised the people's part in promoting progress. In his reply to several addresses presented to him by several organisations in Bangalore in December 1912 soon after he assumed the Dewanship, he noted with regret that while they told Government what to do, there was no offer of what the people were prepared to do.

In another speech soon after, he said the Government's Policy was to help the people, to help themselves. He recognised, however, that the circumstances of the country were not favourable to rapid progress both because of internal weaknesses and external obstacles like the British imperial and economic interests. He had been in office for less than two years when the first World War broke out and the bulk of energies of the State had to be diverted to the war effort.

Within a year of taking office as Dewan, Visvesvaraya had the great satisfaction of securing a notable improvement in the political status of the Mysore State. After ruling the state directly for about fifty years, the British Government returned it to the Indian ruler by a unilateral instrument of transfer in 1881. The relation between it and the other Indian states at the time were governed by bilateral treaties. Mysore wished to be placed on par with other states by a treaty. Visvesvaraya took up the question in right earnest and secured the assent of the Rt. Hon. Edwin Montagu, the Under-Secretary of the state of India of Lord Hardinge, the Viceroy and Governor-General of India, during their visits to Mysore in 1913, and welcome announcement was made by Lord Hardinge on November 6, 1913 that the Instrument of Transfer would be replaced by a formal treaty. His Highness the Maharaja handsomely acknowledged the contribution of Visvesvaraya to the happy result. In his letter of November 22, 1913, His Highness said:

> "I take this opportunity, after the conclusion of the Viceroy's visit, of expressing to you my sincere gratitude for all that you did in connection with the Instrument of Transfer. I fully realise the fact that the success of my representation to the Viceroy was in no small

measure due to the able and convincing manner in which you put the case before him and I cannot sufficiently thank you for the great service you have thus rendered to me and my state and which I shall always remember with feelings of deep gratitude."

The Treaty gave full powers of internal administration of the State to His Highness the Maharaja, and increased his powers and status, subject to the paramountacy of the Paramount Power, as in the case of other Treaty States.

To anticipate, when India became an Independent Democratic Republic in 1947, Mysore acceded to it and was accorded a somewhat subordinote status in the actual working of the Federation, which Visvesvaraya hoped would be a passing phase in the evolution of a new democracy. His wish has since been fulfilled.

CONSTITUTIONAL REFORMS

Having secured an improvement in the external status of the State of Mysore, Visvesvaraya turned to constitutional reforms within the State. If the Government was to be what the People made it and needed the co-operation of the people in fuller measure, he felt it desirable to give' larger powers to the representatives of the people. He had watched democratic parliaments in operation in other countries where the great majority of the people were educated and were animated with more or less similar ideals and aspirations. The conditions in Mysore at the time were somewhat different and the questions of wider franchise and greater powers to representative institutions in the State at the time bristled with difficulties. In December 1912, soon after he took over the Dewanship, he confessed to great hesitation in approaching the problems of constitutional reform without a thorough preliminary study, but promised to give his best attention to the subject. Constitutional reforms in the State were subject to the approval of the Paramount Power, which was not easily forthcoming because of their repercussions of British India.

In his first address to the Mysore Legislative Council, on April 4, 1913, he foreshadowed reforms in the structure and functions of the Council and the Representative Assembly with a view to ascertaining to an ever-increasing degree the wishes of the people in the governance of the State, and drew attention to the fact that with the addition of two new members elected by Representative Assembly, the Legislative Council had a nonofficial majority, comparable to similar legislatures in British India at time.

In his first address to the Mysore Representative Assembly, on October 11, 1913, he invited the views of its members on questions pertaining to its composition, election, functions and procedure for the consideration of the Government. At the same time, he announced that the strength of the Legislative Council would be increased and its members given the privileges of discussing the Budgets and of putting interrelations, subject to certain limitations. In subsequent years, the franchise for the Representative Assembly was widened and its powers were enhanced. With a view to enabling it to comment on the annual Budget before it was passed, a second session of the Assembly was held from 1917. The Representative Assembly was a large body with only consultative powers, and some of its members were not familiar with the Tenglix language. Budget was prepared in Kannada. The Legislative Council was a smaller body with power of legislation. It had an official majority to start with and a non-official majority subsequently.

Visvesvaraya's intention to democratise further the Legislative Council and the Representative Assembly and increase their powers was threatened by the World War which lasted for some four and half years of his Dewanship of six years. The British Government could not countenance any constitutional reforms during the war emergency.

Visvesvaraya liberalised the constitution and powers of local bodies like municipalities and district and taluk boards by increasing the elected element, by the appointment of non officials as Presidents and by organising Conferences for pooling information and experience. Village Improvement Committees were organised to implement improvements in their administration.

While providing for the increased association of non-officials through elected bodies, Visvesvaraya felt the need for improving the efficiency and integrity of the officials by the introduction of an "efficiency audit", which he considered as necessary and important in India as the financial audit. The "efficiency audit" took continuous action to preserve discipline and efficiency in the Government Departments and service personnel, to systematise work, compile rules and standing orders, prepare office manuals and investigate complaints and irregularities.

The separation of executive and judicial functions had long been advocated by the Indian National Congress in British India, but it was not taken up. Visvesvaraya took the initiative in Mysore and made the necessary arrangements to put it into operation in two districts to start with, but the actual implementation took place some years later, after he had retired.

THE ECONOMIC CONFERENCE

The Mysore Economic Conference was par excellence. Visvesvaraya's conception and instrument of economic planning for Mysore, were lessons for India. As already stated, he started it when he was the Chief Engineer. He developed it when he became Dewan. The Conference had three main Committees, dealing with agriculture, industries and commerce and education, with a pretty comprehensive organisation throughout the State for the collection of statistical facts, as accurate as was then possible, to disseminate modern information, give practical guidance, and enthuse the people for galloping progress. Year after year, he presided over the Meetings and Assemblies organised by the Conference, flooded the delegates with information regarding India in the context of other nations, coaxed and cajoled, admired and admonished, stirred and inspired them to greater and more rapid effort towards economic advancement.

He gave topmost priority to education and of all grades. He was deeply impressed by the phenomenal progress of education in Japan in pursuance of the Code of Education promulgamated by the emperor, in which he said among other things:

> "All knowledge, from that necessary for the daily life to that higher knowledge necessary to prepare officers, farmers, merchants, artisans, physicians, etc., for their higher respective vocations, is acquired by learning. It is intended henceforth that education shall be so diffused that there may not be a village with ignorant family with an ignorant member."

He was also impressed by the progress of education among the women of Japan and was impatient for similar progress in Mysore and India. He initiated a vigorous drive for the spread of elementary education, the education of Harijans and of girls. He passed law for compulsory primary education and introduced it gradually. The Maharani's College in Mysore was raised to a first grade College and the first hostel for women students was opened in his time.

For Technical education, he opened the Agricultural School, the Mechanical Engineering College, the Commercial School, the Industrial School in Bangalore and Industrial School in the district. He promoted the Engineering College in Bangalore as Mysore Students found it increasingly difficult in Madras and Poona. A special feature of his administration was the award of a large number of scholarships to enable promising students to go abroad, particularly to America, for higher technological educations.

Finally came the University of Mysore. He called the large number of Universities in other countries like Britain, America and Japan, and wished Mysore should have at least one

University. He referred to it in his speech on March 16, 1912 to the Central College, Bangalore, when he was Chief Engineer Bangalore. It might start as an examining body and develop into a teaching University. His idea faced opposition from influential quarters. The University might not be recognised by the other Universities on the ground that its standards were not equal to those of the others. But Visvesvaraya was determined and met all criticism and finally overcome the opposition and secured the goodwill of Lord Hordinge, the Viceroy and Governor General who gave his consent on the eve of his departure from India. He had the satisfaction of being responsible for the first University in an Indian State afthe time which was started on July 1,1916.

Visvesvaraya felt that, while agriculture was the basic industry of Mysore, industries contributed to the prosperity of the people. Through the Economic Conference and the Industries Department and otherwise, he was responsible for starting a great variety of industries by Government and by other private sector with the encouragement from the Government. Among them may be mentioned sericulture as a cottage industry, sandalwood oil factories in Bangalore and Mysore, the Government Soap Factory which manufactured among others, the famous sandal soap: a metal factory, and a chrome tanning factory. He nationalised the existing railway system in the State and built new railway lines. He improved the Century Club in Bangalore, promoted the starting of the Modern Hindu Hotel in Bangalore and Guest Quarters in Mysore and added the New Public Offices in Bangalore. The irrigation facilities under the Krishnarajasagara Dam permitted the development of the sugar Industry in Mandya.

Visvesvaraya realised the fundamental importance of iron and steel for modern industrialisation. As Mysore had iron ore of good quality, he was keen on starting a factory to manufacture iron and steel. But coal was not available in the State and it was uneconomical to import. So he decided to use charcoal, which could be made economically from the vast local forests, and adopt the method followed in some parts of America and Sweden of substituting charcoal for coal in the iron industry. But as the World War was still on, the Government of India did not sanction his scheme. So he had to be content with making plans ready for implementation as soon as possible.

The actual construction of the Iron and Steel works had begun just a few months before Visvesvaraya retired from the Dewanship, and the project languished for several reasons, among them neglect, opposition from vested interests and the difficulty of securing the necessary experts. About that time the prices of iron had gone down to less than half what they were when the scheme was sanctioned. At that stage an S.O.S. was sent to Visvesvaraya to rescue it, if possible. He agreed to do his best, provided he was given a free "hand. He took over the Chairmanship of the Board of Management in 1923, and during the six years he was in charge, he reduced the operation to a system, reduced the costs to level originally estimated, trained a local staff and maintained the production at a satisfactory level, and made the work pay their way! It was a great achievement. The American consultant, who had earlier advised the closure of the works, cabled his congratulations to Visvesvaraya. The Maharaja said that it was an achievement which the state could be proud of. When he finally retired from the Iron and Steel Works, the Maharaja wrote a personal letter of appreciation and thanks, and assured him that nobody appreciated his good work more than his Highness. A feather in Visvesvaraya's cap was that he sold Bhadravathi products in the American market at competitive prices.

In appreciation, Visvesvaraya was allowed a fairly large sum as his fee as Chairman of the Works. He generously handed it back to the Government with the request that it should be used to build and equip an occupational institute in Bangalore, to be named after the present Maharaja, His Highness Sri Jayachamarajendra Wadiyar.

VOLUNTARY RETIREMENT FROM DEWANSHIP

About 1916- 17 the non-Brahmin movement, which had started in Madras, spread to Mysore and the local non-Brahmin leaders pressed that the policies of that movement should be introduced in Mysore. In essence, it was that the more advanced community, namely Brahmins, should be held back by restricting their admission to educational institutions or otherwise reducing their opportunities for acquiring education. Visvesvaraya was unable to sympathise with this policy. He perused a policy of spreading education and giving special scholarships to the backward communities to acquire education. By spreading it rapidly and by adopting precision methods in production and industry, the whole population would, in his opinion, progress faster. And the policy was showing results. He feared that by ignoring merit and capacity, production and efficiency would suffer. There was never any complaint that he favoured any particular community. Under pressure from the non-Brahmin leaders, the Maharaja appointed a Committee to placate them, Visvesvaraya was opposed to it and tendered his resignation. But it was kept a closely guarded secret for eight months, till he could tie up the loose knots and round of commitments. It was finally announced in December, 1918, a few days after the war ended.

In laying down his exalted office, Visvesvaraya had the satisfaction of knowing that all the works for which he was responsible had shaped well, and all the criticism, which was inevitable, had been hushed by results which had exceeded expectations. In his farewell to the Secretariat on December 9, 1918 he claimed with justifiable pride that he had not deviated from the principals and policies he had professed when he took office and that he held the scales even between communities and regarded the welfare of the Ruler and his people as his first concern. He was painfully aware, he said that he had not attained all his ideals and that all which could have been done was not accomplished for various reasons, some among them being the war and British opposition. But it may be said of him that few attempted more, or in such unfavourable circumstances, achieved more.

Though Visvesvaraya resigned his Dewanship, he continued to be held in the highest estimation by the Maharaja and was offered a special pension, and he readily responded to invitations for his services on subsequent occasions, as the salvaging of the Bhadravathi Iron and Steel Works. He was Chairman of a Committee to design a new scheme of water supply to Bangalore, and of another Committee for the construction of the Irwin Canals under the Krishnarajasagar and of yet another Committee to enquire into the unfortunate disturbances in Bangalore.

Retirement from the Mysore Dewanship did not reduce the intensity of his work but only enlarged his field. He was in great demand allover India for high level consultation in designing schemes for water supply, irrigation, drainage, river-training, etc. In 1924 he was invited by the Bombay Corporation to suggest proposals for retrenchment of expenditure and reform of administration. He submitted reports in 1924 and 1925, recommending reductions of expenditure of about Rs. 15 lakhs, and decentralisation of functions and the allocation of specific duties to heads of departments, the institution of a municipal research bureau, and stricter control of Public utilities managed by private companies. He also recommended that the public should be kept constantly informed of municipal projects and developments and frequently consulted by a Central Board, appointed by Government.

He was invited to undertake a thorough investigation of the financial position and general administration of the Karachi Municipality and submitted a valuable report. He did somewhat similar service to Baroda, Sangli, Morvi, Wenkaner, Pandharapur, Ahmednagar, Bhopal, Mysore, Nagpur, Bhavanagar, Rajkot. Goa and several others. Another major problem which he was invited to tackle was to devise methods to control the periodical floods in Orissa. His report laid the foundation for the Hirakud and other dams on the Mahanadi.

Visvesvaraya was very keen on starting the automobile and aircraft industries in India. In 1935, he travelled extensively in Europe and America, visited several automobile and aircraft factories, discussed possibilities and plans with the leaders of the industries, like Henry Ford in

America and Lord Austin in England, and helped to draw up plans to instal factories in India. But the Government of India vetoed the project, much to his disappointment. It was only after the Dunkirk disaster in the second World war that the British Government permitted the building of the Aircraft Factory in Bangalore and finally took it over as a Government concern.

Visvesvaraya participated as Chairmen or Member in several committees after his retirement from the Mysore service, some of which have already been mentioned. His experience as Chairman of the Bombay Technical and Industrial Education Committee, appointed by the Indian Minister under the Montagu Constitution in 1921, was very disappointing. The Committee consisted of ten Britishers and seven Indians. Lord Lloyd unsuccessfully attempted to persuade Visvesvaraya to fall in line with the Britishers. Not only Visvesvaraya but also the public were sorely disappointed with the majority Report of the Committee.

When the Bombay University proposed to take the initiative in the matter, the Government appointed a Committee on University Reform, which seconded the majority report of the Committee on Technical and Industrial education. Where upon the Bombay University decided to appoint a Committee independent of the Government with a smaller objective the starting of a University department for chemical technology with Visvesvaraya as Chairman. This Committee made an unanimous and favourable report, and this resulted in the establishment of the Bombay 'University Chemical Technology Institute.

Visvesvaraya was invited to be Chairman of the Committee on Irrigation Policy appointed by the Bombay Government in 1937. Its terms of reference were comprehensive and its report was practically unanimous. It recommended among other things the introduction of the "block system" of irrigation meetings and Conferences to bring officials and cultivators together for mutual explanations and understanding, and to provide for continuous study and research by the Institution of a Provincial Irrigation Board and an Irrigation Research Bureau. Most of the recommendations were accepted by the Bombay Government.

He was appointed a member of the New Delhi Enquiry Committee in 1922 to report on the development of the new capital. He was appointed Chairman of the Indian Economic Enquiry Committee in 1925 to report on the availability and adequacy of statistical material to assess the economic conditions of the various classes of people of India. The Committee recommended a regular economic survey to collect the relevant facts to facilitate the formulation of economic policies. Its British member submitted a dissenting note. It was obvious that the committee only met as a political gap to discourage agitation.

In 1926, he was appointed a member of the Back Bay Enquiry Committee to enquire into the history of the inception and operation of the Back Bay Reclamation Scheme about which there was much public agitation at that time and serious allegations were made against the Government, including the British Governor, Lord Lloyd. The Committee recommended the abandonment of further reclamation, the curtailment of some projected works and the development of the areas already reclaimed. The Government did not come out in shining colours.

The Bombay Government appointed in 1929 a small Committee of two Indian engineers of which Visvesvaraya was the senior to report on the complaints regarding the operation of the Sukkur Barrage in Sind. They accepted the Committee's report and implemented it in the next ten years.

Science, pure and applied was of special interest to Visvesvaraya. He was connected with the Indian Institute of Science from its very inception in several capacities and was the Chairman of its Court from its very inception in several capacities and was the Chairman of its Court from 1938 to 1947. He was largely responsible for securing closer co-operation between pure and applied science in the Institute, and for creating several new Departments. In 1923 he presided over the Tenth session of the Indian Science Congress in Lucknow.

In the industrial field, he was a Director of the Tata Iron and Steel Company for twenty eight years from 1927 to 1955. He was the Founder and continuing President of the All-India Manufacturers Organisation. In 1946, he led a delegation to Britain and America and visited several factories, including automobile and aircraft units power stations and the Tennessee Valley Authority, and on returning to India published a valuable report of nearly three hundred pages.

Visvesvaraya delivered Convocation Addresses to the Andhra University in 1939, the Benoras University in 1940, and the Mysore University in 1948, and honoured the University of Bombay, Mysore, Benaras, Andhra, Calcutta, Patna, Allahabad and Jadhavapur by accepting Honorary degrees indifferent years. In 1958, he was awarded the Durga Prasad Khaitan Memorial Gold medal by the Royal Asiatic Society of Bengal. He was a Member of the Institute of Civil Engineers, London and a Member of the Institute of Consulting Engineers, Calcutta and a Fellow of the Institute of Town Planners, India, and other learned bodies.

While Visvesvaraya's main interests have been the promotion of economic development and all that contributes to it, he took part in political problems when he was free to do so, after his retirement from Government service in Bombay and Mysore, and he was a keen student of political affairs right through. When Lord Chelmsford was Viceroy, and Mr. E.S. Montagu, the Secretary of State for India, visited, India in 1917 to study the political situation and make recommendations for political advance, Visvesvaraya suggested that the Indian Princess should be associated with the Second Chamber. Montagu noted in "An India Diary" that Visvesvaraya was right in making the suggestion and Chelmsford was among in opposing it. It is interesting to note that the Montagu Chelmsford Report on Indian Constitutional Reforms recommended the creation of a Council of Princess as a permanent consultations between it and the Council of State. Later, in 1920 Montagu invited Visvesvaraya to the Council of the Secretary of State for India, but he declined the offer as he had made other plans.

In 1921, Visvesvaraya was drawn into British Indian Politics. The Prince of Wales was invited to visit India by the Viceroy Lord Reading. Mahatma Gandhi who was organising civil obedience called for a boycott of the Royal visitor. The situation became both delicate and explosive. With a view to easing it, some leaders in British India proposed to wait in deputation on the Viceroy and persuaded him to call a Round Table Conference. Visvesvaraya joined it. On its failure to achieve its objective, an All-Parties Conference was convened in Bombay, which Mahatma Gandhi was persuaded to attend. Sir C. Sankaran Nair, who had recently resigned in pratest from the Government of India was chosen to preside over it. He left the Conference on the second day as he disapproved of some' resolutions. In the emergency, Visvesvaraya was prevailed upon to take the chair and he conducted the rest of the proceedings. The Conference appointed a Committee to conduct negotiations with the Viceroy for a Round Table Conference and Visvesvaraya was its Chairman. When the negotiations fell through, the Committee faded away.

Visvesvaraya presided over the South Indian States Peoples Conference in 1929 in Trivandrum and recommended that in any proposed constitutional reforms the interests of the Princess and the peoples of the Indian states should be safeguarded.

Economic development through industrialisation on a planned basis has all along been the principal objective of Visvesvaraya. It has been the constant refrain of all his speeches and addresses, particularly when he was Chief Engineer and Dewan of Mysore. He drove his theme home with an imposing array of the best comparative statistics from all countries that he could gather at the time, and capped it with the slogan. "Industrialise or Perish". After his retirement from Mysore service, he gave a connected and comprehensive survey and suggestions in his books, lire-constructing India", published in 1920 by P.S. King and Son, London, and "Planned Economy for India", published in 1934 by the Bangalore Press, Bangalore. As has been said already, he was the pioneer of planned economy. He advocated a ten year plan for India as a whole and five year plans for the then British Indian Provinces and Indian States, which he elaborated in his Planned Economy for India which was written when India was still a dependency of Britain and her industrial advancement was frowned upon by British interests.

The aims and procedures advocated by Visvesvaraya decades ago are still relevant. He wished to make the Indian the equal of his compeer in America, Europe and Japan as a citizen as a national and as an international personality in the shortest possible time. In eloquent and moving words he pleaded for economic councils which could command national confidence which would listen and be listened to with respect throughout the country which would keep in touch with the masses and inspire them to self improvement.

"In accomplishing this aim and end-the-end and aim of regenerating the national will for accomplishing national well being India will be acting not only for herself but also for the world at large. An Indian, economically strong that is industrially efficient, educationally high and in collective co-operative effort thoroughly modernised would provide a source of strength in the new stage of human development itself. That stage is now coming and it cannot indeed be long delayed. The age of new capitalism of balance order and discipline of co-operation within and between nations is fast on us and it is the duty of India to shed her age long apathy, deficiencies and defects and evolve a Plan of Work that will help her to retain her best feature of the individualism to which she has long been so deeply attached and yet build up to advantage that system of collective effort without which economic salvation today is all but impossible. To solve this problem the ideals of sacrifice surrender and service should be accepted in the place of mere individual gain, personal profit and single objective. That is the role that awaits new India". Said Visvesvaraya.

Such is his message of economic advantage based on ethical foundations. Such is Visvesvaraya's unique, one without a second. It is said in ancient Indian lore that the ocean can be compared only with itself and the Himalayas with themselves, and with no other. Visvesvaraya can be compared only with himself for there is no other like him. He is a rare combination of ancient Hindu Bhishma and modern American Ford.

By P. Kodanda Rao and H. Rangachar

Visvesvaraya tried his best to secure a unanimous report, but failed as the British members, supported by the British Governor, lord Llioyse were opposed to higher technical education for Indians and the Indian members were in favour of it and the former were in a majority.

Courtsey: WORLD STATE
Special Number on
Bharatratna Dr. Sir. M. VISVESVARAYA,
Edited & Published by S. Visveswariah

Shri K V Chaubal—a Brief Profile

Having had his school and college education in Gujarat, Shri K V Chaubal (born on December 6, 1927) obtained his first-class B Sc (Hons) degree from the University of Bombay in the year 1947, and post-graduate Diploma in Electrical Technology from the Indian Institute of Science, Bangalore, in the year 1950.

Shri Chaubal, a Ute Fellow of the Institution of Engineers (India), has been the Honorary Secretary of the Maharashtra State Centre of IEI. He has served as the Honorary Secretary, Chairman and International Council Representative of the Institution of Electrical Engineers (London) in its Bombay Intenational Centre.

Shri Chaubal has been closely associated with IEI for nearly three decades, having joined it as a Member in 1970 and was transferred to Fellow in 1972. He has been instrumental in organizing several career-enrichment programmes under the auspices of the Maharashtra State Centre of IEI and has displayed his dynamic leadership quality. As a member of the National Council of IEI, he guided its affairs in various capacities such as Member of the Finance Committee and Chairman of the Electrical Engineering Division Board of IEI.

He has also served on various Committees of the Indian Standards Institution, in addition to various undertakings of the Government of India as well as those of the Government of Maharashtra State, dealing with power sector. He had been associated with Indage (India) group for some years and also served as a Director on the Boards of various private sector companies. He retired as Vice Chairman-cum-Manqging Director of Bombay Sub-urban Electric Supply Ltd, Mumbai.

Characteristically selfless, unobtrusive, unassuming and of general disposition, Shri Chaubal is a many-splendoured personality, much loved and respected in the profession. His election has indeed been a momentous recognition of his achievements on one hand, underscoring the Institution's commitment towards continuing with its efforts to attain the highest level of technological excellence and professional competence on the other. It is hoped that under his dynamic leadership, the Institution will scale greater heights in fulfilling the aspirations of the nation.

Prof Ajoy K Ghose
President 1998-99

Presidential Address

REVISIONING A PROFESSIONAL INSTITUTION FOR SUSTAINABILITY

It is a great honour for me to be standing in front of you to deliver this address. I thank the Council for giving me this opportunity to serve. I have been preceded by many illustrious Presidents who have held this office with great distinction. Using up to the standards of dedication and service set by them will be no easy task. Thinking about the year ahead fills me with a sense of excitement. The challenges are many and difficult, but the possibilities are endless. I look forward to the support and cooperation of my distinguished colleagues of the Council and of the fraternity of engineers at large.

Our nation and culture date back many thousands of years, but as we celebrate the last 50 years in charge of our own destiny we must consider the role that we engineers may play in national development. Our country deserves better — it deserves to be the best. How engineers might playa key role in ensuring economic progress and how IEI might facilitate this process in a viable and sustainable manner are the two questions I wish to address today.

Our Institution was founded in 1920 and will become an octogenarian when we enter the third millennium. We are today possibly the largest professional body of engineers in Asia and an eminent learned society consisting of 15 distinct disciplines of engineering besides being the largest open university in engineering disciplines in the country. It may be worthwhile to quantify some of these dimensions. Our corporate membership on 1-1-1998 was 72000 and non-corporate membership was 320000. We have 92 centres across the length and breadth of the country as well as 5 overseas chapters. The Institution conducts examinations for some 90 000 aspirants every year and qualifies some 3500 graduate engineers through the Associate Member of he Institution of Engineers (AMIE) route under the Charter of 1935. We have bilateral links with the national engineering societies of 15 countries and are members of 7 world bodies.

We live in an age in which change is constant. We must embrace change to be viable. To be able to implement change in an effective manner, we must know where we are headed and what our goals are. The key, therefore, is a clear articulation of a vision for the organization. Vision, for an organization, is often defined in the following manner:

VISION = MISSION + STRATEGY + CULTURE

The Charter of 1935 lays down for us the mission of the institute. Strategy represents the plan of action that we adopt to achieve the goals set forth for us. Culture refers to the ritual ingredients encompassing what we stand for, the values we hold dear as well as norms, procedural or otherwise, within the organization. Both strategy and culture are dynamic. Both can and must change.

A vision for lEI must be anchored in reality. To undertake a revisioning exercise, one needs to undertake a SWOT exercise to recognize our strengths and weaknesses, as well as opportunities that we may exploit and the threats that they pose. Let me unfold the results of a cursory SWOT exercise.

- Strengths:
- A far-flung multi-professional society with a large and often high-profile membership base.
- Learned society activities at 92 centres on a continuing basis.
- A wide range of scholarly publications for the dissemination of research results.
- Membership (as National Member) of international bodies such as WFEO, WEC, WMC and HP, amongst others.
- High international standing and bilateral links with 13 nations/national organizations.
- The largest open university for engineering in the world, graduating over 3500 engineers every year.
- Additional infrastructure for education and training at the Engineering Staff College, Hyderabad.
- Strong asset base.

Weakness:

- Slow decision-making processes, organizational inertia and resistance to change arising from the Council structure of governance.
- Increasing cost of membership and functions.
- Low level of interaction with industry.
- Large supporting staff structure.
- Low levels of utilization of Information Technology (IT) in organizational processes.
- Absence of awareness of the need for total quality in customer service for members.
- Poor record at retaining technician members after graduation.
- Inadequate channels of communication with the Government, industry and members.

- Poor utilization of resources and inability to become a learning organization; staff training is non-existent.

Opportunities :

- Ramifying the institution through the sinews of the nation for partnership and cooperation.
- Increasing international activities in collaboration with the WEC, WFEO, WMC, RP CEC, etc.
- Emerging as a partner to government in national development at all levels through the Rural Development Forum and the Water Management Forum.
- Emerging as an umbrella organization for coordinating the activities of all professional societies in India.
- Formal recognition as an open university through enlarged horizons for teaching and training of engineers.
- Developing the Engineering Staff College as an international centre for continuing education in engineering.
- Becoming an active participant in the National Board of Accreditation and assuming greater responsibility for accreditation.
- Developing international accreditation for membership qualifications.
- Assisting in quality monitoring and assurance in all engineering functions.
- Recognition of members as a resource for nation-building.
- Assuming a more influential role at the national level in formulating policies on engineering education, R & D and infrastructure development.

Threats :

- Competition from other professional societies.
- Complacency and faulty perceptions.
- Inability to manage change through the espousal of IT adoption and quality principles.

The above listing, though by no means exhaustive, provides us the signposts for development, prioritizing the multiplicity of items on the action agenda. In my perception, all these must become the ingredients for revisioning the Institution's future and for formulating strategies. While we may cry hoarse for formal recognition as the leader amongst professional societies, the mantle will automatically descend on us if the institution becomes proactive, raises the level of technical activity and articulates cogently and forthrightly the viewpoint of engineers on all major issues of national concern.

Let me outline my vision for the lEI. In the first instance, I envisage a professional society of engineers actively engaged in the task of fostering economic growth, ensuring a prosperous future for our nation. As with any organization, the engineering profession of this nation must focus on two key issues:

- ensuring the highest standards of quality in every aspect of professional practice.
- focusing on and capitalizing on areas of core competence as well as areas where significant competitive advantages exist.

Let us consider the question of quality first. As engineers, we must make a total commitment to quality. Engineering practice in this country must set the highest standards for the profession worldwide. We must reach a point where the whole world looks to us for the best in engineering innovation. We must reach a point where our engineering colleges and universities become the preferred destination for budding engineers worldwide. The IEI must play an active role in fostering this quality-oriented transformation of the engineering profession in the country. It can achieve this by laying down and enforcing the highest standards in engineering education and by constituting advisory as well as monitoring groups to inculcate this commitment to quality.

Conventional wisdom in business management tells us that focusing resources and effort on the areas of core competence, or on the areas on which a business possesses a significant competitive advantage often proves to be an effective strategy. In a somewhat different manner, the same strategy applies to the engineering profession in our country. We must identify areas that we are good at and devote additional resources towards ensuring a leadership role in those areas. One example of such an area is Information Technology, especially software. Software written in India commands respect the world over. We may exploit the clear competitive advantage we have in this area by launching a special initiative to establish India as a world leader in engineering applications of IT.

Other areas of core competence must be identified and exploited in a similar manner.

GRASS ROOTS INFRASTRUCTURE

With the primary focus on poverty alleviation, especially in the rural sector, the IEI must dedicate its efforts through all centres on rebuilding infrastructure through the grassroots level of the nation. While the role of IEI may be largely advisory at the district level, one can also think in terms of implementing some model projects at selected centres. I had the opportunity of seeing the work of the Local Government Engineering Department of Bangladesh, which has made impressive strides by integrating itself into infrastructure development activities at all levels. Assuring the absence of constitutional barriers, members of the IEI can act as advisors to District Commissioners throughout India for all development work. More importantly, the Rural Development Forum, acting through local centres, can prepare blueprints for development within their territories and help identify the areas calling for urgent reform. In fact, a major initiative needs to be mounted to reinvigorate the Rural Development Forum and the Water Management Forum so that they become active at all centres of the Institution, instead of being exclusive to Calcutta or Ahmedabad. The Water Management Forum will have a heavy agendum in the Third Millennium, as water becomes the most critical resource of the future. We need to utilize the Dublin Principles of 1992 as well as the principles enunciated at the follow-up conferences at Rio, Noordwijk and Cairo. As a finite and vulnerable resource, water must be managed at the lowest appropriate level, using a demand-based participatory approach.

The Institution must make a tangible impact on other critical areas that face the nation such as environmental management and sustainable energy management. Whilst the IEI had earlier constituted an Interdisciplinary Group on Sustainable Development, this has been largely dormant for the past few years. This needs to be rejuvenated as a separate forum to oversee the sustainability of all development activities. The International Conference on Habitat at New Delhi last month organized by the IEI under the aegis of the WFEO underscored the fact that sustainable development remains the most basic challenge-facing humanity. To meet this challenge, long-term commitment and concerted action is required and the lEI has to take a major initiative in eco-efficiency and address the key issues through responsible and determined action.

NEW HORIZONS FOR MEMBERSHIP GROWTH

The Institution has to strive to assiduously to expand its membership base and elici1:industry support by inducting larger number of "Institutional" and "Donor" members. The Institution has already broken away from the traditional mould of exclusiveness by creating new classes of membership such as "Associate" and "Affiliate" members to induct professionals from the industry.

We have to devise ways and means of upgrading the level of "customers service" vis-a-vis members in-line with the principles of total quality management. With a focus on quality, improved communication, increased technical activity at local, national, and international levels, recognition of our members as a resource for the government and industry, vastly expanded Information Services and new opportunities for continuing professional development, the Institution should surely attract hordes of members of all classes within its folds. It is also necessary that our Journals become more relevant with contributions from professional practice and state-of-the-art reports so that we open the window of new and emerging technologies to our discerning members.

TOWARDS AN OPEN UNIVERSITY

While the Charter empowered the Institution to "provide for the holding of classes and to test by examination or otherwise the competence of such persons" and "to grant certificate of competency", the Institution traditionally has been an examining authority and has not involved itself in teaching *per se*, barring some coaching organized at a few centres. In the changed educational environment, with a focus on delivery modes by Distance Learning Systems, flexible and self-paced learning techniques and mixed mode systems, we must explore the effective application of educational technologies to support such programmes.

With the concepts of "Virtual University" being toyed about, delivery systems using Video-Conferencing and other IT tools such as the Worldwide Web appear possible. The Institution must also consider diversifying into management education through a strategic alliance with a management institution and offer an MBA (Technology Management).

The Engineering Staff College could be the centre piece for new experiments in distance learning and for implementing principles of total quality management. Without formal recognition, the Institution is by peer recognition an Open University which, through continuous improvement initiatives of TQM, should excel in all its academic functions. The immediate needs are for the publication of texts and reading materials for distance learning and quality assurance in the examination system.

REENGINEERING THE INSTITUTION

There is much scope for reengineering the basic organizational processes of the Institution to make them more efficient. This would call for developing IT assets (human resources, technology base and partnering relationships) within the IEI for long-term viability and competitiveness. We need to rapidly build an IT capability which must permeate throughout the organization, be it in membership, finance, examination or technical support services. Currently, efforts are under way for evaluating a well-defined IT architecture and the overall IT priorities for the Institution. We have to. involve all functional departments and develop skills through massive training programmes.

IT solutions help in improving connectivity between the Institution headquarters and centres, faster decision-making and work-simplification. In the 21st century, all of our personnel must become computer-fluent as we move to "automate, informate and transformate" the lEI. We have to be careful in the alignment of the technology and the organizational environment for effective implementation.

ISSUES MANAGEMENT

The IEI has fo become the mouthpiece of the engineering profession, taking heed of all issues of concern, even if they tend to be contentious issues such as the status of engineers in society, environmental activism, policies on infrastructure development, etc. Infrastructure, according to the World Bank's 1994 Development Report, "represents, if not the engine, then the wheels of economic activity"and the building of this infrastructure has been the core business of engineers. Yet, the engineers are often criticized by the political system. It is our duty as engineers to take our rightful place in the decision-making process.

The IEI has to engage in a massive public relations campaign to stake its claim for the good work done by the fraternity of engineers through quality publications on engineering accomplishment and the broadcasting of programmes telling the nation that the quality of life that we enjoy today has been made possible by the engineers.

The emotive exhortation to engineers by Wiliam D Lewis, a past president of RDIC, deserves to be quoted:

> "Let us step out of the shadows of anonymity and exercise leadership in the challenges facing the world in the 21 st century. We must become authoritative voices to plead the case for sustainability and prudent resource utilization. Let's quit talking to ourselves and communicate with those who can restore our image. But our voices will not be heard, unless we step out of the crowd and up to the podium. Will the invisible profession please step forward?"

I believe I have put forward the components of a vision framework — a prescient point of view about the road to the future. It cannot be achieved in a year, or even two, but we have to make a start somewhere and provide some threads of continuity. Leveraging our resources, our envisioned future has to set specific and may be even audacious "stretch goals", which can spur momentum, energizing our Institution.

We have many miles to go to translate into action the engineers' shared dream of a new India, of growth, innovation and prosperity, in the next century. The Institution of Engineers (lndia), a Goliath amongst professional societies, has a seminal role to discharge in rebuilding our India. Bound as we are by a common commitment to promote engineering and facilitate its practice for the common good based upon shared values of innovative practice, competent performance, engineering excellence, ethical behaviour and sustainable development, let us start on a voyage towards excelsior.

A Brief Profile

Prof Ajoy K Ghose, AISM (Min), FCC, HE, P Eng, FNAE, a distinguished mining engineer and academic, has been elected as the President of the Institution of Engineers (India) for the session 1998-99. Born in April, 1934, Prof Ghose had a distinguished academic record at Patna University and the Indian School of Mines. He was a Management Trainee with the National Coal Board (UK) between 1957-59 and qualified in the Associate Membership Examination of the Institution of Mining Engineers (London) receiving the Laurence Holland Medal and Prize and the Austin Hopkinson Medal. After a short stint at Indian School of Mines as a Senior Lecturer, he joined the Central Mining Research Station of CSIR as a Senior Scientific Officer, Grade I, in 1960. At the early age of 28, he was selected as Professor (Senior Scale) and Head of the Department of Mining Engineering at Regional Engineering College, Srinagar. He returned to Indian School of Mines in 1966 as Professor of Mining Engineering and worked successively as Head of the Department, Coordinator of UGC Special Assistance Programme, Centre of Rock Excavation Engineering, Dean (Planning& Development) and was the Director of the School with the rank of Vice-Chancellor between 1991-94 until his retirement. In between, he was Visiting Professor at the University of Newcastle upon Tyne in 1973-74, a Visiting Scientist at the University of Ostrava, Visiting Faculty at the University of Nottingham and Academy of Mining and Metallurgy, Cracow, and worked with the Pennsylvania State University under the US-India Cooperative Science Programme. Between 1994-96, he was a UGC Visiting Professor and AICTE Emeritus Fellow at the Bengal Engineering College. He is currently a Retainer Consultant and edits two journals besides advising the mining industry as a Consultant. He is a part-time Director of Central Mine Planning and Design Institute, Ranchi and a member of the Board of Governors of Birla Institute of Technology. Prof Ghose has undertaken extensive industrial consultancy for the industry, served as Local Consultant to the World Bank and ILO, and executed assignments in Bhutan and Nepal for the ESCAP, and worked in Indonesia and Tanzania.

Besides significant contributions to mining engineering education, Prof Ghose has been responsible for the development of outstanding facilities in rock mechanics and rock excavation engineering, a unique Experimental-cum-Training Mine for Indian School of Mines and a new MBA programme. He initiated major research studies in the area 'of rock reinforcement techniques and is credited with the development of the first practical rock mass classification model for design of roof bolting which has gained wide industry acceptance. His contributions in the area of longwall ground control, in-situ stress field in underground coal mines, acoustic emission of coal measure rocks are considered as seminal.

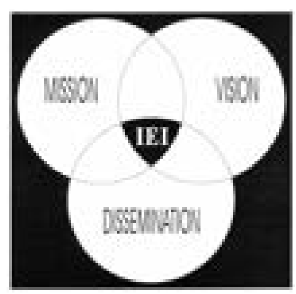
Prof Ghose has been active in several professional institutions and has been a member of the National Council of the IEI since 1968. He is a Past President of the Mining, Geological & Metallurgical Institute of India (1987-88; 88-89) and a Fellow of Indian National Academy of Engineering, a founder of the International Society of Mining Professors, a member of the International Bureau of Strata Mechanics and a member of the International Organizing Committee of the World Mining Congress since 1977, of which he is currently a Vice-Chairman. He is a Honorary Life Member of the Polish Association of Mining Engineers and Technicians (SITAG). For his significant contributions to research, academics and advancement of professional practice, Prof Ghose has received many national and international awards which include inter alia National Mineral Award, National Design Award in Mining Engineering, Krupinski Medal of the World Mining Congress, Dewan Bahadur D D Thacker Coal Mining Medal, etc. Prof Ghose has published over 350 scientific papers in national and international journals and conference proceedings and has edited 14 books and monographs.

Prof (Dr) M P Chowdiah

President 1999-2000

Presidential Address

INTRODUCTION



I am extremely happy, feel privileged and consider this opportunity to address you as a great honour. I am not sure whether I can fully justify the confidence you have reposed in me, but still I can assure you that I would sincerely contribute my best towards the overall growth of this great Institution. All of you know that, The Institution of Engineers (India) [IEI] (founded in 1920) has been playing a pivotal role in the growth of our great motherland. I am proud to mention here that IEI has been a source of inspiration to many in surfacing their engineering skills culminating in reaping benefits in different sectors (ie, the Mission of IEI).

I am sure you all will agree with me that IEI should continue to play this vital role more effectively in future too (ie, the Vision of IEI). On this momentous occasion, I feel that it is our ardent duty to express our sincere gratitude to all those who have strived their best in bringing this great organization to what it is today.

In a world of rapid technological advances, we still need a large pool of qualified engineering personnel to cater to the ever increasing demand of the industry and society as a whole. In this context, the society expects that IEI should rise to the occasion, wherever necessary, in delivering the fruits of scientific developments along with technological advancements judiciously in order to improve the quality of life of common masses. Past experiences indicate that how important it is to effect the changes in organizational structure that are required from time to time in order to effectively shoulder the responsibilities it is changed with. Considering this, we have to take a relook at what this great organization can do for the overall growth of the country, particularly keeping in view the challenges ahead. A scan of the world scenario, in respect of the great pace at which the advancement in science and technology is taking place world over, and in particularly developed countries, would make one feel that it is the time that the country should catch up with the rest of the world. At the same time, I particularly feel that a constant vigil should be maintained in utilizing the benefits achievable during such technological developments or their spin- offs especially keeping in view the rural masses of our country (ie, the Dissemination of Technology for rural development).

Keeping these in view, I place before you my thoughts in three different sections, namely;

(i) the Mission of lEI,

(ii) the Vision of lEI, and

(iii) the Dissemination of Technology for rural development.

MISSION OF lEI

In this section, I start with the organizational structure first.

Organizational Structure

The growth of any organization and what is expected of it at any point of time are completely interdependent. I mean that the expectations grow on par or more than the actual growth of any organization itself. This would naturally lead to the need-based structural changes in order to meet the challenges the organization is faced with. Let us now view our organization - lEI - with this perspective.

It may be noted that lEI was founded in 1920 and the Royal Charter was granted to it in 1935. By virtue of this Charter, any Corporate Member of this Institution can designate himself as "Chartered Engineer". It took nearly thirty five years for the Institution to transfer itself into a real multi-disciplinary professional body progressively growing into fifteen divisions of engineering. The expectation of members from the organization grew in terms of continuing education courses in engineering and its related subjects which resulted in the establishment of Engineering Staff College of India (ESCI) at Hyderabad in the year 1981. Shortly after, IEI had subsidiary functionary fora in the name of National Design and Research Forum (NDRF) at Bangalore; Water Management Forum (WMF) at Ahmedabad; Rural Development Forum (RDF) at Calcutta and Sustainable Development Forum (SDF) at Patna to aid and assist effectively in the areas of indigenous design and research, judicious management of water resources, transfer of technology to grass root levels and sustainability of any developmental process, respectively in order to meet the overall objectives of IEI. Likewise, the international connection of IEI also grew as an active member of several professional societies the world over including the World Mining Congress (WMC) and the World Federation of Engineering Organization (WFEO).

A quick look at the increase of the Corporate Membership (which was 138 in the year 1920 growing to over 4.2 lakh in the recent past) indicates the enormous growth the organization has undergone. Similar trends could be observed in respect of journal publication, candidates appearing for the associate membership examination, etc. All these indicate how the organization has grown over the years incorporating timely changes in the organizational structure in order to meet the ever increasing requirements of the engineering fraternity. Now a time has come to realize a better and increased personal rapport between the IEI and its vast membership force.

Regional Centres

With the rapid increase in the growth of membership along with activities of the organization in several spheres, it has become extremely difficult to manage the whole system effectively since the burden on the Headquarters is ever increasing. This calls for a basic change in the organizational structure without much financial burden for regional services. In this direction, I wish to propose the following.

There will be four Regional Centres of IEI each catering to Northern, Eastern, Western and Southern parts of India, headed by three Vice Presidents and the President of IEI. Each Regional Centre would be housed in one of the State Centres of the region from where the Vice President comes (conveniently from the logistic points of view). Similar pattern of governance is seen in other international professional societies including the Institution of Electronics and Electrical Engineers (IEEE), and the American Society of Mechanical Engineers (ASME). The overall responsibilities including the publication of journals and their distributions and general correspondence with the members of different categories, can appropriately be distributed among the four regions. I also propose that the senior-most Vice President would take over as the National President in view of the rich experiences he gathers over the years in his capacity as Vice President. A new Vice President would then be inducted for that particular region and thus the continuity be maintained. This results in a maximum of three years term for the Vice Presidents and one year for the President.

Publications

I am pleased to inform you that the standard of different journals currently being published by IEI has considerably gone up in terms of technical content. However, I am sure, you will agree with me that we should not be complacent about this improvement but rather strive hard in maintaining the standard as far as practicable. At this juncture, I would like to make an "off-the-record remark" that there is a general tendency for Indian researchers to publish their findings in foreign publications which make me deeply concerned. I call upon the fellow researchers to review their choice and make the IEI journals more rich (in content) by contributing articles and thereby elevate the standard of IEI publication in future.

In order to give an international flavour to IEI publication in its literal sense, an attempt should be made to have technical papers (from other countries) published in our journals. This calls for giving wide publicity in different appropriate fora/media the world over. One could also ponder over inviting experts from India and abroad to contribute technical papers for publication in IEI journals. I would like to further suggest that a selected few articles from the proceedings of the Engineering Congress could be published in relevant IEI journals. In addition, I sincerely request all my fellow engineers/researchers to kindly suggest ways and means by which the IEI journals would make their mark internationally.

Student Fellowship / Talent Identification

In an effort to encourage the budding engineers' talent, I plan to institute IEI Student Fellowships. The different state centres would be requested to identify the top ranking students at Higher secondary level (who intend pursuing higher education in the technical field) who would then become eligible for the said fellowship. The detailed mechanism of such selection would be worked out shortly in consultation with the National Council of IEI. I intend to create a Corpus Fund to meet the expenditure in this respect with the help of individual philanthropists, philanthropic organizations, industries, governmental bodies, corporate members and alumni of IEI.

The said Corpus Fund would also be used to provide partial financial assistance for those who present technical papers in international/national conferences of repute. I propose to set up a National Committee for the purpose.

IEI—A Statutory Body

It may be recalled that IEI was accorded the Royal Charter by the British Empire in 1935 which was interpreted by the former Attorney General of India as equivalent to an act of parliament. This status enables the IEI to voice its opinion on different aspects of national importance (in the field of engineering) which were viewed seriously by the British Empire. I am pained to inform you that IEI does not enjoy such a prestigious status in independent India. It is my earnest ambition to see that such status is revived at the earliest.

Open University / Higher Education

Although there has been a tremendous growth in the engineering academics and technical institutions, a short fall in engineering manpower is still felt in view of increased demands in various spheres. The IEI has all along been playing a vital role in trying to bridge this gap through its non-formal technical education and conduct of examination, popularly, known as AMIE Examination. However, the gap still exists in respect of specialized disciplines which calls for establishment of educational facilities for higher learning in various engineering disciplines. The IEI, with its huge existing infrastructure allover the country in conducting examination and being first in the world to start distance education, should gear itself in meeting this challenge. An open varsity status for the examination wing of the IEI would facilitate in achieving this goal. I suggest that the Headquarters of the varsity should be located at the Engineering Staff College of India, Hyderabad. The proposed varsity should explore offering postgraduate level courses in diverse disciplines of engineering. At this juncture, I am pleased to inform you that, IEI has already set up a working group for achieving a Deemed Open University Status which is expected to submit its report shortly. Upon receiving the same, IEI would approach the appropriate authority/ies for establishing an open varsity. I assure you that I will spare no efforts in realizing this during my tenure as President.

Creation of Database / Network

In this modern era of information technology, it has become extremely easier to have access to any information in the public domain. It is high time that IEI equip itself to make use of the available facilities. The IEI, in this regard, can expand its services to its members in various spheres including:

- access to other information database across the world;
- information about intellectual property rights and patents;
- information on the expertise available in different branches of engineering, particularly within the country; and
- placement services (by way of creating information on jobs available and on job seekers).

I feel that IEI, in order to achieve the above, should join the vast INTERNET family. This would facilitate the members from all corners of the country to reap the benefit from the related services offered by IEI. As a first step, I strongly suggest that IEI should create its own Website to make available the above information. This would facilitate the public in general and members in particular to make use of the database so created.

As a next step, IEI should explore the possibility of linking the different state centres as the sub-centres with a final objective of attaining complete office automation.

It is my privilege to assure you that I will do my best to put IEI on the INTERNET map, which in my opinion is a very good beginning in realizing the above.

Accreditation

With increase in number of technical institutions (at the polytechnic and degree level), a time has come to continually monitor the quality of technical education. A scheme of gradation would vastly help in improving the quality defined in terms of infrastructure and the teaching faculty. Such a process of accreditation is being carried out by non-governmental organization in other parts of the world. I understand that the process of accreditation has been entrusted to a governmental agency in our country. Nevertheless, I am of the opinion that IEI can and should playa vital role especially in view of the availability of expertise within the organization. The modalities of the process of accreditations should, however, be worked out in detail. I plan to constitute a committee for arriving at a mechanism for implementing the process of accreditation, as an impartial and multidisciplinary non-governmental organization (NGO).

Challenges Ahead

In my opinion, the engineers and technologists are the two main players who trigger and expand the process of transforming the very quality of life on earth through an array of technological innovations. The demands, especially on Indian engineers and technologists, are on the increase and are highly challenging in view of increasing trend of customer needs and globalization of the market. I am sure you all would agree with me that India is one of the richest nations in terms of intellectual populations and what is needed at present is to maximize and efficiently harness the talent of this brain power. This is extremely important from the point of view of the fact that although India is said to be the third (now can be considered as the second after the disintregation of the erstwhile USSR) in the world in the manpower of science and technology by quantity, it ranks eleventh among the fourteen industrialized nations in terms of 'international competitiveness'. The role of engineers and technologists becomes all the more important since more than 50% of economic development (globally or locally) is attributed to technology development and deployment At this juncture, it is the duty of each and every engineer and technologist to rise to the occasion in meeting the challenges in various sectors and playa vital role in Indian Economic Development Process.

Indian Scenario

In the wake of revolutionary advances at global level in several sectors, a sound approach to planning development, delivery and application of modern technology assumes great importance. Keeping in view the Indian scenario, such attempts become extremely essential in different sectors including energy, water management, infrastructure, agriculture, pollution and waste management, communication, information technology, manufacturing technology and biotechnology apart from other high tech sectors like aerospace, advanced materials and genetic engineering.

The shortage of energy has been felt perennially although there has been a continuous growth in generation of power. It is disheartening to note that the demand for power is increasing at a faster rate compared to the generation of power. It is time that this gap should be narrowed and bridged totally. In my opinion, the first step to narrow this gap is to create awareness in the society — be it individual or organizational — to harness power from renewable energy sources like solar and hydel. I insist that greater importance should be given to this aspect in view of the degrading environment and prevailing ecological imbalance. The participation of private sectors in joining hands with governmental agencies in tackling this problem effectively should be explored, since a concern still exists regarding harnessing power from alternate energy resources.

A dreaded fear exists regarding the shortage of water for domestic and agricultural purposes in near future. A judicious water management has to be implemented. 'Catch the rain where it falls" should be the '*Beeja Mantra*' in order to elevate the depleting water table along with an emphasis on implementation of drip irrigation technology.

The veins of the country have been the roads and all of us agree that the development of this core sector has been neglected for quite some time. It is heartening to note that our beloved Prime Minister has taken this aspect very seriously and has announced laying of 'A 7000 Km Highway' connecting the length and breadth of the country at an estimated cost of Rs. 280000 millions. I call upon all the individuals and organizations in extending their fullest cooperation at all levels in this endeavour.

We are all very happy about the effort and progress made by the Department of Space in linking the nooks and corners of the country by efficient satellite communication network. It is heartening to note that ISRO made a striking success by launching INSAT-2E multipurpose telecommunication satellite on April 3, 1999 at 0333 h 1ST. It is appropriate that we record our appreciation. We are proud about the position our country is enjoying in its emergence as an international giant in the area of information technology. The main challenge in this sector, in my opinion, is to see that our country would reach the top and maintain that position in future, not become just software producers, but to be designers and users.

Role of IEI

Let me now dwell on how effectively IEI can play an important role in meeting the above challenges. We are all happy to note that IEI has already involved itself to a great extent and is in continuous process of bringing awareness in the society through various technical discourses such as conducting seminars, workshops, continuing education programmes, symposia, round tables, etc. Important themes on emerging areas of technology are being identified from time to time and discussed at different levels in various divisions. The activities in this regard have greatly been assisted by the already existing fora of IEI — ESCI, NDRF, RDF, WMF and SDF. While this activity should continue with greater fervour, a deeper involvement in hand core contribution by IEI should be explored. I have been thinking in this line for quite some time and I would like to put forth my thoughts to the august body for consideration and feed back.

I do not have to emphasize the need for creating the R&D activities — be it in any field of engineering — particularly in view of the growing global competitive customer market. As far as the Indian scenario is concerned, although there is a good lot of R&D organizations catering to various sectors, a need for increased R & D activity is still felt from the point of view of common man's day-to-day problem, be it at the rural or at the urban level.

In this connection, I propose to set up R&D centres which could be located at different state capitals. The running of these R&D centres would initially be taken care of by the state centre until such a time these become self sustaining. At this stage, I would like to dwell upon what is expected out of these 'IEI R&D Centres'. I expect that these centres would identify the problems of regional interest in order to offer possible solutions. An expert committee relevant to the problem identified can be constituted headed by the representative of the respective centre with an end objective of clearly defining and freezing the problems. The committee can later identify the expertise available in that area and explore the possibility of sponsoring the R & D activity to the identified expert group. I am of the opinion that the financial implications could be worked out in consultation with the end users. The different state centres should give wider publicity regarding such centres resulting in creating an awareness among the general public and the industry houses. This becomes all the more important for small-scale industrial sector since they may not have R&D activity of their own. In my opinion, this is absolutely essential in spite of the existence of a few organizations catering to R&D needs of small-scale industries.

Any problem, technical in nature, can be classified into two categories depending upon the type of solution offered. The solution offered can be of a short-term or of a long- term approach. In this context, I would like to emphasize the need for a serious forward looking research to be undertaken in the country. I suggest that the respective R&D Centres, in association with the local academics/industrial institutions should identify forward looking research projects which should be undertaken with a long-term perspective in view. I propose to set up a Corpus

Fund in financing either fully or partially to undertake forward looking research projects alone. I appreciate the measures taken by CSIR in encouraging the new ideas in the national laboratories. I am sure we all agree that the role played by IEI will have far reaching consequences. We should, at this juncture, place on record the yeomen services rendered by NDRF, WMF, RDF and SDF in addressing the various problems. I am of the opinion that while R&D Centres should concentrate on problems relevant to regional interest, the subsidiary fora of IEI should tackle problems of national importance.

While I understand that achieving sustainable development is relatively difficult, we should make all-out efforts in realizing the fruits of sustainable technology. Sustainability, in my opinion, can be defined as a property of a system wherein the state of growth of the system is more than the rate of harvesting from the system. It is time that we pursue the technologies sustainable as per the above definition. At this stage, I would like to emphasize the application of sustainable management and utilization of natural resources. Experts have felt that sustainable developments in developing countries should be people-centred and through participatory management as a culmination of decentralized governance. I am pleased to inform you that the lEI has been playing a key role in this respect through one of its fora — ie SDF. However, I should make a point very clear saying that our dream of realizing the sustainable development is very closely linked with the population control in our country. Notwithstanding such obstacles, realizing that a good part of Indian economic strength lies in the large number of villages, we should strive hard in introducing sustainability for rural development.

THE VISION OF lEI

To dwell on this subject, I recall the yeomen services rendered by this great Institution in the past whenever occasion arose and assure you its best in future occasion too.

The Ebb and Flow of Resurgence

We are still exploring the best way to enter into the twenty-first century. We seem to visualize abundantly that market segmentation and diversity are in natural harmony. People differ not only in the usual ways — by age and gender, by race and nationality, by education and occupationand by marital status and living conditions — but also in their activities and interests. However, despite prevailing diversity in our society, there are also many similarities. Segmenting target audiences on the basis of such similarities make it possible for marketers to design marketing strategies with which consumers will identify. Social stratification, the division of members of a society into a hierarchy of distinct social classes, exists in all societies and cultures.

Evolution is a process of inevitable improvement. Consciousness and its offspring — culture — change everything. Technology is not separate from society and people are not nature's puppets, which underlines the fact that the expansion of our imagination leads to encompass the diversity of things. Art and science are different enterprises but the boundaries between them remain far more fluid and interdigitating and the interactions far richer and more varied. By learning from the technologists of the past, we can better understand ourselves. And in the minutiae of their lives and works, we can grasp something of the best that we can. As unique creators, scientists and technologists are always on the way to do something better.

This moving and noble sentiment brings us closer to a more matured contemporary society that can identify the most important ingredients of success in a period of rapid change. Technological developments are the only plausible explanation for the explosion of wealth that has taken place since industrialization. It is at least arguable that all changes, including social and organizational, have their roots in technological developments.

Nevertheless, the global economy, battered by recession, has perhaps put privatization and globalization on hold for now. This year's Human Development Report (HDR) observes:

'Today's consumption is undermining the environmental resource base. It is exacerbating inequalities. And the dynamics of the consumption — poverty — environmental nexus are accelerated'. In the last fifty years, world consumption has increased six-fold to reach $ 24 trillion. The consumption of fossil fuel has doubled since the 1960s. Our planet is producing waste beyond its capacity to absorb or convert. In the last half of this century, carbon dioxide emissions have quadrupled. Cities have become gas chambers. Global warming has assumed alarming proportions. Many developing countries are facing the rage of nature for the fault of an affluent few. While the recent consumption explosion offers greater choice to people, there is an increasing polarization of wealth, which may spell doom for the global economic system. There is an acute dearth of purchasing power and demand among the deprived sections of the population. The onus of deforming the global order cannot be passed over to them. There should be a social audit and violators must be made to pay. The new paradigm would require people to be educated and informed, driven by human values and not be dictates of the markets, and enlarged opportunities to participate in key decisions on freedom and democracy. Emphasizing education at all levels, promoting strong links between universities, research laboratories of the country and industries, building new infrastructure, putting in place economic policies that encourage risk-taking innovations, establishing methods of assessing technological risk-taking and promote venture capital institutions and setting up networks involving technologists, governments, academics and financial institutions heighten the dire need to update our self-perception, if we have to move towards a better future. We can still attempt to find a solution for effective use of economic value of skills available here in 'Mahatma Gandhi's philosophy — that the haves shall be the trustees of the have-nots, that the present generations shall be the trustee of resources for future ones, that human being will be the trustees of entire eco-systems. Likewise, the key to promoting cultural diversity in the global village may be contained in Mahatma Gandhi's advice to allow the breeze from the open Indian windows to influence the nation, but not topple it. There is hope that disquieting trends will be reversed.

Keeping in view these and other related core issues in the forefront, this leading learned engineering professional society, the IEI, has seriously strived to highlight with social concerns that improvement in the quality of life for the large number of historically disadvantaged people in our country is entirely feasible if the themes discussed at the Annual Indian Engineering Congresses including the present one on the theme 'Information Technology for Sustainable Competitiveness' are any indication.

I would like to touch upon a few such strategic and non-strategic areas of development where Indian technology could be held in a leading position with considerably autonomy.

Biotechnology

If biotechnology research is to become a tool for sustainable, ecological and socially responsible development, a bottom-up publicity funded approach would be needed. This would allow for identification of real needs through participatory strategies, the use of appropriate technologies and respect for peoples resources and knowledge. Unless the seed and chemical industry changes course from purely profit motivation towards sustainable development, biotechnology will spell the death of small-scale eco-farmers in favour of profits for Trans National Corporations (TNCs). Diversification value addition and concerns for sustainable agriculture, environmental protection and globalization of agriculture would require necessary adjustments in our genetic engineering research prioritization and planning. The ultimate objective of altering the genetic architecture of plant for improvement in agriculture for amelioration of diseases, through genetic engineering may appear as a viable option in the next millennium. Disease resistant plant, obtained by genetic engineering replaces chemicals with seed, allows a national agricultural programme to replace expensive annual imports or expensive capital-intensive local production with products that utilize local resources. Thus, equivalent disease control with an engineered seed has potential to reduce or eliminate a major annual expenses to the grower and replace it with what may be considered a renewable resource.

Indian Space Programme

It is gratifying to note that self-reliance (not only in the development of satellites and their operations in the orbit, but also to launch them from within India) has been the watchword of Indian Space Programme. The space system today form an important element of the national development infrastructure. The system will be sustained and further enhanced in the coming years, increasing the role they play in the coming years, increasing the role they play in the national developmental tasks, especially in the areas of telecommunication, broadcasting including for training and developmental education, meteorology, disaster management and monitoring and management of natural resources. The programme shall remain dynamic and responsible to the developmental needs of the country, like multipurpose satellite INSAT-2E launched successfully on April 3, 1999 at 0333 h IST.

Nuclear Capability

Commercial aspects of exploiting nuclear capabilities have recently been given high priority. Given the overall energy situation in India, our use of nuclear power in some measure is inescapable even while thermal and hydro power continue to be the dominant sources. Even to meet these nuclear power requirements, India critically requires a commercial level power generation capability, with its arrangements. Thus, in the Indian context, energy security is also crucial because India imports a good part of its crude oil requirements, paying for it with precious foreign exchange. The growth of nuclear technology indeed has become a trendsetter for many high technologies in India.

Technology by 2005 AD

By 2005 AD, more industries will be in a position to take up stand-alone mode systems engineering and systems integration to the specified requirements of R & D organizations. Sub-systems like multi-door radar, 'Keveri class aircraft engines, total carbon fibre composite wings, display systems, fly-by-wire systems for LCA and for futuristic aircraft, mission computers and airframes will be developed, engineered, produced and delivered for integration and check-out. The nation will have multiple options on choice of systems and industries to make them competitive and cost-effective. In certain sub-systems or technologies, we can even compete globally. There would also be a number of civilian commercial spin-off products and services which can be marketed domestically and in foreign markets too.

Information Technology

With the emergence of digital technology (including computers), data transmission has pervaded all aspects of life under the name of 'Information Technology (IT)'. There are good possibilities for India to emerge as an IT superpower, with a large share of world business and also by being the originator of many new IT and software systems in the world. Services and applications are expected to expand from voice, video-conferencing and high band width data applications in 2000 AD to extensively high band width services available in education, health and entertainment. The overall vision includes continual efforts to spread services to a large number of rural areas, which would call for innovative systems and flexibility in policies. A very wide range of CPE should be available and in use in the country. Specifically, we are likely to witness the widespread use of broad band CPE for applications running on the ISDN and the beginning of computer — telephony integration. We can expect routine use of multimedia terminals by 2015 AD providing video telephony and video-conferencing applications on demand. One of the elements necessary to make India a major IT power is to strengthen IT education in the country. Many engineering and science colleges have to be facilitated to introduce modern IT courses with the private sector and even with foreign funded initiatives. Constraining monopolies have to be removed and new approaches to be attempted. Creating a large human resources cadre in all aspects of IT is the crucial infrastructure for India to become a major IT player.

However, the technological areas critical for the growth of strategic industries for India are in the aviation and propulsion sector, high-end electronics, sensors, space communication and remote sensing, critical materials and processing, robotics and artificial intelligence. The relations of the 'Information Age' to culture must be understood in a more general perspective. Multicultural, multilingual, democratic India has a unique opportunity to head the world in assuring that the information age does not simply produce a flat, superficial, and materialistic monoculture. Cultural diversification can be strengthened, if Indians agree on common standards for Indian languages, commit resources to localization and use technologies like multimedia to record and diffuse the rich cultures of this nation.

The INTERNET has enabled the so-called network economy that is changing the paradigms of commerce and trade. Apart from a change in how we do business, there is an emerging social shift which is rendering our lives; a shift whose impact may well parallel that of industrial revolution. What we clearly see is a global restructuring around multiple axes: wealth flows from innovation (increasingly the very rich comes from the very high tech industry), abandonment of the high successful known (the mainframe computer, for example); and speed of change (shrinking life cycles). Of course, global deregulation and privatization will dictate the pace at which these changes can be brought about. The recent past indicates that various national governments will have no choice but to let the forces of deregulation rule. The deregulation process needs to eventually address all aspects of the structure of the information industry: creation and collection of content, display and storage and application and distribution. Today, even in the most advanced countries, there does not exist a single umbrella organization that can re-regulate these multiple aspects.

The developing countries are likely to fall into a grave debt trap, if they make heavy investments in IT infrastructure without simultaneously making long-term plans for generating substantial surpluses using IT. The goal of providing universal access to IT may bring with it the risks of various rights being undermined. These risks are especially serious since the checks and balances that are essential to maintain the rights are yet to be put in place, even in developed countries. Appropriate security mechanisms do not as yet exist, and will require legislation to prevent the theft of valuable indigenous technology in various domains (such as agriculture and medicine) and hence the lots of invaluable intellectual property disruption of the economy by malicious or accidental damage inflicted on IT infrastructure and misuse of IT to abet oppression and exploitation. Existing international bodies as well as emerging IT-specific international organizations can contribute substantially to promoting standardization, which is critical to the rapid growth of any new technology, through adoption of new standards that are specially relevant to IT in local languages and establishing responsive and inclusive processes for international standardization.

Challenges Ahead

We have to undertake giant strides to fulfil the fresh aspirations of the people in the coming century. The farmer has to be able to use his land and labour to not merely sustain himself and his family but to earn the wealth that lies in his land. The working class should be able to share the prosperity that is now confined to a very thin layer of the population.

We have to create the social base for a new spirit of industrialization based on the partnership of the Public and private sectors, foreign and indigenous capital.

There is an urgent need for developing societies to direct resources to education, health care, poverty alleviation and a clean environment. The economic take-off requires an educated and socially secure population. Without investments in human capital, investments in every other form of capital fail to yield optimal results. Human capital is the link with the future and so is central to growth and development, and also the very heart of typical modern economy. Many economic issues as of today, cut across the boundaries of urban and rural areas. In the process, there is urbanization of rural areas and the ruralization of the urban settlements. The process though, looks like creating conflicts, is likely to settle down and correct the disharmony with passage of time, and both areas enriching with the socio-economic and cultural advances from each other.

Singularity of Higher Education

In a world of tremendous technological advances, we still need a large pool of qualified engineering personnel because they will become the pivotal point in industry and society as a whole. Thus, the planning for technical education should be based on a vision of the future. The most important focus is to train and develop institutes of excellence, like ESCI and other fora of IEI. Still, the fresh technical personnel have been finding it difficult to cope with the challenges of newer technologies, which drives home the point that there is a gap between technologies that are currently in use and technologies taught in our academic institutions.

Experiences and suggestions show how important it is to support institutions in their necessary process of expanding and restructuring their aims, contents and organizations so that they make effective provision. At a time of increased uncertainty and confusion, this is a precondition for survival — largely urban — of continuing education markets of the future and for the institutionalized aspect of lifelong learning. The quality of staff and their initial and in service training motivation and qualifications are part of this process, as is institutional and financial security. Alliances and institutions that represent cross-class or cross-cultural interests — initiatives to combat corruption defend human rights or prevent discrimination — can offer new possibilities for popular education.

The human resources who fail to meet the requirements of virtual companies, centres of excellence, technology cultures, intelligence networks, information and communication, superhighways and the like will be considered obsolete, worthless, and will be cast aside and abandoned. They will no longer be subjects for initiation into new depths of knowledge, nor will they be objects assigned to new training or skill upgrade schemes. This will apply as much to the human resource as an individual as to the collective human resources assembled in a village, a neighbourhood, a town, a region, a country and even a continent. Seen in this light, training policy in its role as a producer and disseminator of the collective assets known as knowledge, skill and talent must be seen as an integral and decisive factor in the movement calling for the course of global development to be economically efficient, socially suitable and politically democratic. Far from being reduced to a weapon for conquering markets and eliminating competitors, training should be our efficient medicine for augmenting global communal public wealth. Instead of excluding, training should aim to pro-literate forms of co-existence and co-development. There is a need for forces in quantity to mobilize under this banner.

The curriculum model will have to take into account the shift that the Indian industries will undergo during the next decade. The life-cycle of the curriculum will be shortened to a large extent. More emphasis on trial and error and frequent improvement and updating of curriculum will replace the time consuming conventional model. Skill pattern is likely to under sea change. Curriculum model must aim at developing a new brand of technical manpower with operative, acquisitive, adaptive and innovative capabilities with major emphasis on generic and learning-to-Iearn skills to match with the dynamically changing environment. Universities are meant to groom the emerging generations to cope with the tough, competitive world outside their gates. Any nation that cares for the future cannot neglect its universities and it is the primary task of the latter to keep up with time schedules set for themselves by commencing the academic year, holding the examinations and announcing the results on time in right earnest.

In view of the low output of students and diminished quality factor in the context of growing demand in a dynamic economy, there is an urgent need for engineering colleges/polytechnics to work out a quality system for their own institutions by interpreting the relative clauses of ISO: 9001 and adopt them for reaping substantial benefits.

R&D Niches

R&D is the vital force, for the continuance of technology innovations and industrial growth. Excessively escalating expenditure on R&D requires that the management of higher technical education and research takes new initiatives to develop efficient manpower and relevant R&D. To meet this objective, forms no local needs is as much vital as the universalization of education and research. It must clearly be understood that while knowledge is universal, the technology is need specific and is dominated by local constraints and present environment. Continuing education of the work forces involved in R&D activities will pay rich dividends to ensure the competitiveness and sustain the contributions to absorb rapid advances in science and technology. More effective linkages between educational institutions, R&D organizations and the industries hold the key to a promising R&D growth. In this effort, the networking of resources of all partners is equally important to share the burden in R&D expenditure. Mission-oriented and new specific R&D should take priority on open ended knowledge specific research.

The spiraling efforts for the development of newer manufacturing technologies are simply mind boggling. Manual machines of yester years have become today's automated machines. The productivity through higher, faster and superior manufacturing technologies has become the theme or philosophy of every nation, while competing in the global product market. This is envisaged through viable and innovative technological inputs of R & D management of a manufacturing environment. In this context, integration of the three elements of manufacturing, namely, technology, management and work force termed as 'Agile Manufacturing' would constitute an ideal manufacturing programme. It includes the entire business system starting from planning, finance, process, design, tooling, machinery layout, materials and inventory, inspection to pricing, marketing, sales and service, technical support, delivery dates and the like. Practice of this philosophy has become, of late, an absolute necessity in view of the demands on customer-oriented products, to produce components of international standards in terms of quality and cost. Big strides with which information technology (IT) has been growing has greatly contributed to the manufacturing scene. The core of Agile Manufacturing is the integration of information technology. Therefore, the approach is the only solution for leadership in manufacturing for global competitiveness.

Subtlety of Innovations

Innovation is the original creation of a logic to manipulate nature for a purpose. Design is the subsequent use of that logic in products, processes or services. How invention and design are possible provides the basis for planning research for technological progress. Increasingly; the competitive differences between firms (and between countries) have come to depend on their abilities to acquire, develop and focus new technologies as market need. There are only temporary lead times in technology. This makes strategic technologies essential for long-term survival. Space, aviation, computers, biotechnology, information and communication have emerged as a pervasive reality. Development in automation has brought in major revolution in manufacturing technologies. Investment in large infrastructure projects requires tying up at the level of the user costs. America's emergence as a giant economic power was helped in no small measure by the laying of an integrated network of inter- state highways and setting up of land-grant universities. These and other wide spectrum of new technologies are likely to shape our future and the engineering profession must respond to these realities and challenges.

In the post-liberalization era where the road has been laid for foreign investment and faster growth of exports and imports, the expected results still have not been achieved primarily because of lack of infrastructural facilities like housing, transport, communication, water supply, electricity, finance, etc. There are several bottlenecks which are providing a stumbling block in the development. It calls for the promotion of domestic and foreign competition in trade and industrial policy with phasing out of unnecessary legal and bureaucratic impediments and ensuring the availability of good quality infrastructure.

Sustainability

In the light of the foregoing, sustainable development under conditions of a developing country should be people-oriented and must lead to environmental harmony: economic efficiency; resource (including energy) conservation; local self-reliance; gender equality; equity with social justice; cultural relevance; and peace and disarmament. The academies and NGOs, like IEI, dealing with S & T education, social sciences, economics, law and ethics need to take up such studies and prepare status papers for the benefit of the Government. We need to set our own house in order in the first instance. Only then, we can confront the northern consumers who use resources far in excess of the renewable rate. The environment in general and sustainable development in particular have to be on our national agenda, but these have to be above politics like the foreign policy, defence, agriculture and economy.

In this regard, I would like to quote the verse from' Thirukuraf—an indispensable treatise—on ethics and principies :

"Learn whatever that are to be learned without
doubts and distortions and after learning
conduct yourself according to the principles learned".

The message is very clear and relevant in this respect. We have to ignite the powerful knowledge resource and work together to transform the vision of IEI into a mighty professional institution of international repute.

THE DISSEMINATION OF KNOWLEDGE (FOR RURAL DEVELOPMENT)

The core of Indian economy lies in the development of each of the individual villages. By development of the village here, I mean that the individual village should sustain on itself and its resources in attaining complete self sufficiency. Efficient management of local water resources and exploring all means of generating power from within the locally available natural resources form two important constituents of attaining self sufficiency. In this context, I would like to emphasize that science can provide pointers to how the natural and human resources can optimally be combined with appropriate technological inputs. The areas in which the villages have to depend on the external world are the infrastructure, communication network and remote sensing. Remote sensing, for instance, can produce clinical mapping of the land giving information on underground water resources and forecast climatic conditions. At this stage, I would like to bring to your attention about what is happening in our neighbouring countries in this regard. China, where a lot of emphasis has been laid on attaining self sufficiencies of villages is something that we should follow. The main objective there is to see that the villages depend as little as possible on the external world. Although late, I feel that we should strive hard in this direction since we still have not missed the bus.

Let us analyze what IEI can do in this regard. We all know that IEI has been doing a lot in this line through one of its fora — ie RDF. Notwithstanding this, let us explore how state/local centres can involve themselves in this most important endeavour. I suggest that each state/local centre can adopt at least one village and concretize its efforts in achieving the self sufficiency status for that village. The R&D centre should playa vital role in this direction by identifying the appropriate technology/ies in appropriate areas. For instance, the centre may explore the possibility of generating power from mini hydel projects depending on the available resources. I stress that creation of at least one model village should be the goal of each centre.

Amazing Technologies for Rural India

An attempt is made to explain the astounding advancements of technology and their amazing power to meet the rural needs of our country for better quality of life tomorrow. Since these technologies covering various fields are too numerous to discuss, only a few representive cases are chosen. These are: (i) biotechnology, (ii) space technology, (iii) agricultural technology, (iv) communication technology, and (v) recycle technology. These technologies are emerging as global economic forces, as much as their success have already been leading towards betterment not only in rural India but in many such rural environments of the world as a whole.

Biotechnology

Biotechnology has tremendous potentiality in improving the quality of life of rural Indians if the scientific developments in this area are judiciously used in the country.

- The practical applications for this potential technology has been realized in a wide range of areas including new foods, drugs, fuels, plastics, fibres and plant nutrients.
- Since this technology uses cheap and locally available natural resources, it has immense applications in rural developments for solving problems of hunger, energy supply and thereby improving the quality of life of rural folk.
- The genetic engineering aspects of biotechnology has significant potentials to contribute to future agricultural and health care needs created by explosion of population like in India.

— It is already being used to develop diagnostic tools and vaccines for a number of animal diseases.

— It can improve specific plant characteristics like resistance to diseases and pests and to increase water and other stress tolerances.

— Use of toxic materials produced by living organisms and control inspects (in Thailand commercial formulations of Bacillus Thuringiensis have been used as biological insecticide to control agricultural and forest insects/pests, primarily those resistant to all major group of chemical insecticides).

— Introduction of gene coding for protein toxic to insects, derived from bacterium (transgenics plants with complete resistance to insects have been produced to tobacco, potato, rice cone and number of other crops).

— Introduction into the plants genes that inhibit enzymes responsible for breakdown of proteins (Transgenics with cowpeas, protease inhibitor genes have demonstrated resistance to tobacco bud worm, corn ear worm, and horn worm of tomato and tobacco).

- It has expanded our resources in meeting the needs of renewable sources of energy for the rural sector : improved strains of micro organisms may be developed through genetic engineering for production of alcohol and other fuels and renewable biological materials
- It has also enabled many innovations in the method of mass multiplication by tissue culture (recently scientists of the University of Florida have, in collaboration with a firm in Israel, developed a kind of fermenter in which extensive multiplication can be achieved in an economically viable manner).

Space Technology

Space technology plays a significant role in rural development of developing countries like India which can be summarized as :

- satellite-based weather forecasting can give advance information/warning and enable precautionary measures to be taken.
- satellite and aircraft studies enable timely mapping of flooded areas to assess the damage due to floods and take appropriate relief and flood management measures.
- satellite-based accurate weather forecasts greatly aid farmers and advise them on possible crops for seasonal cultivation.
- agricultural drought monitoring and crop stress (pest/disease) detection based on satellite observation enables to initiate control measures tohelp the farmers.
- aerial spraying of pesticides and distribution of fertilizers by aircraft and helicopters (very common nowadays).
- aero-engine gas turbine based pumps are employed in pumping water from off-shore to remote interior areas through several kilometres of pipelines for drinking and irrigation.
- air cargo provides speedy transport of perishable agricultural products (fruits, vegetables, flowers) grown in rural areas to distant urban areas as well as for export and thus provide considerable outlets for the farm products and aid the economic development of rural areas.
- new and improved methods of irrigation such as root irrigation/sprinkler irrigation, etc are made possible by the use of new space age materials (like aluminium alloys and plastics).
- lighter and more efficient driven carts are feasible by utilizing light weight aerospace materials such as aluminium alloys and composites.
- since the substantial portion of food grains are lost to pests or spoiled due to poor storage each year, care has to be taken for light weight and strong composite materials such as GFRF (developed for aircraft) which can be used to make efficient and cost-effective grain storage silos farms.

Agricultural Technology

In this vast field of technology, I will restrict myself into three major areas, namely, green revolution, white revolution, and blue revolution.

Green Revolution

Joint Agricultural Navigation Using Satellites (JANUS) uses what we know about the fields past to guide in its future management. Such precision can give farmers on the spot data so that they can quickly design on how much animal waste, chemical and seed to apply and just where to use them. This is the most economic method to be used in agriculture.

White Revolution

The promotion of dairy technologies will bring work and food to the rural people. The generation of wasteland maps by satellites provides information on distribution of wasteland at village level and identify areas suitable for developing grazing field for high milk yielding cows / buffaloes and also for developing dairy and dairy products by setting up suitable industries in rural areas for groups of villages thereby adding further potential for employment of rural people. At present, only urban people are getting the benefit of this revolution. It is possible to set up countrywide villages-based dairy industry and usher in an era of plenty of milk and milk products—a 'White Revolution' for villages also.

Blue Revolution

Our country has a vast and long sea coast. Waters are warm and tropical — ideal for developing the fishery industry leading to a 'Blue Revolution'. Satellite-based remote sensing can be used to locate fish schools and breeding grounds and correlate fishery potential with a various oceanic parameters such as ocean colour, turbidity, thermal fronts, etc. Such identification of potential zones and planned exploitation can increase fish yield to meet increasing food demand, and can thus be a pointer to the economical betterment of fisherman and coastal rural population. Thus, the Blue Revolution can be extended to mainland and fisheries in natural ponds and tanks and artificially created ponds in farm fields if water and fodder (poultry/animal wastes) are available.

Communication Technology

The successful use of remote sensing in building databases of resources like lands, waters, forests, minerals and agricultural produces for rural sector is well known. Advances in micro-electronics, opto-electronics, optical fibres, computers, materials, electronic components, space technologies and alternative energy sources have richly contributed to a veritable information revolution. The technology, if exploited properly, will greatly help to upgrade rural life by educating them in the latest technologies pertaining to agricultural and other rural activities and to improve the living conditions thereby.

In the field of health care, for example, company officials say that doctors and other care givers will be able to consult with specialists thousand of kilometers away, share medical records and X-rays, relay critical medical information during epidemics, ensure priority routing of medical supplies during disaster relief programmes, and provide remote instruction, sanitation and pernatal and infant care.

Recycle Technology

Recycle/reuse technology is very pertinent now-a-days since the natural resources in a country like us are getting depleted at a much faster rate due to over population and use of obsolete technology. I am of the opinion that a serious attempt should be made by all concern to use recycle/reuse technology for sustainability. Production of wealth and resources from waste should be the motto of each and every waste generating units so as to maximize the return (in terms of value-added products) and also ensure a cleaner production and environment.

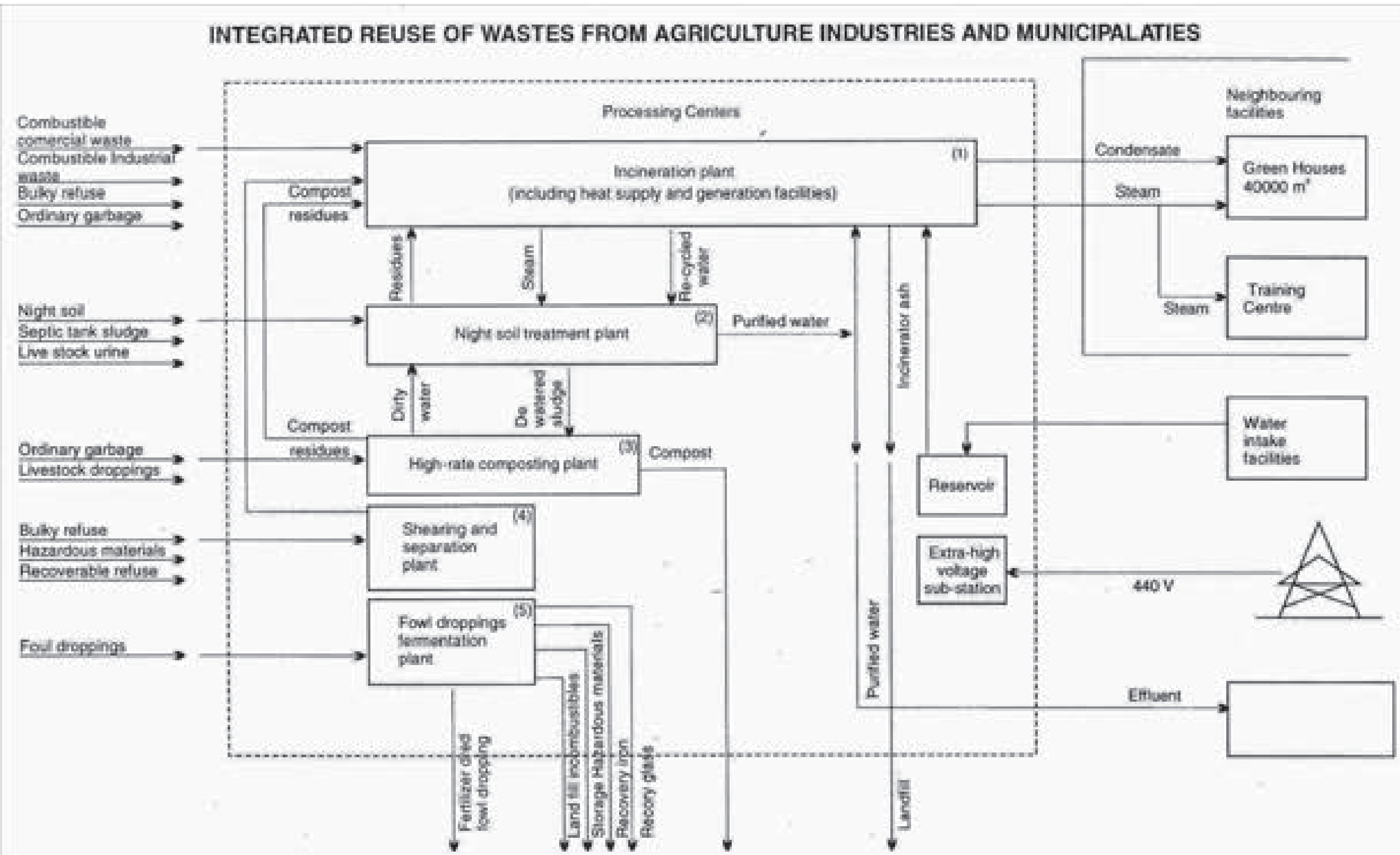
CONCLUSION

Technology is a forcing concept but it operates on a time scale long enough to confound casual observation. 'What history has taught us', says Mr Robery White of the National Academy of Engineering in the US, "Is the power of technology to expand the world's resource base".

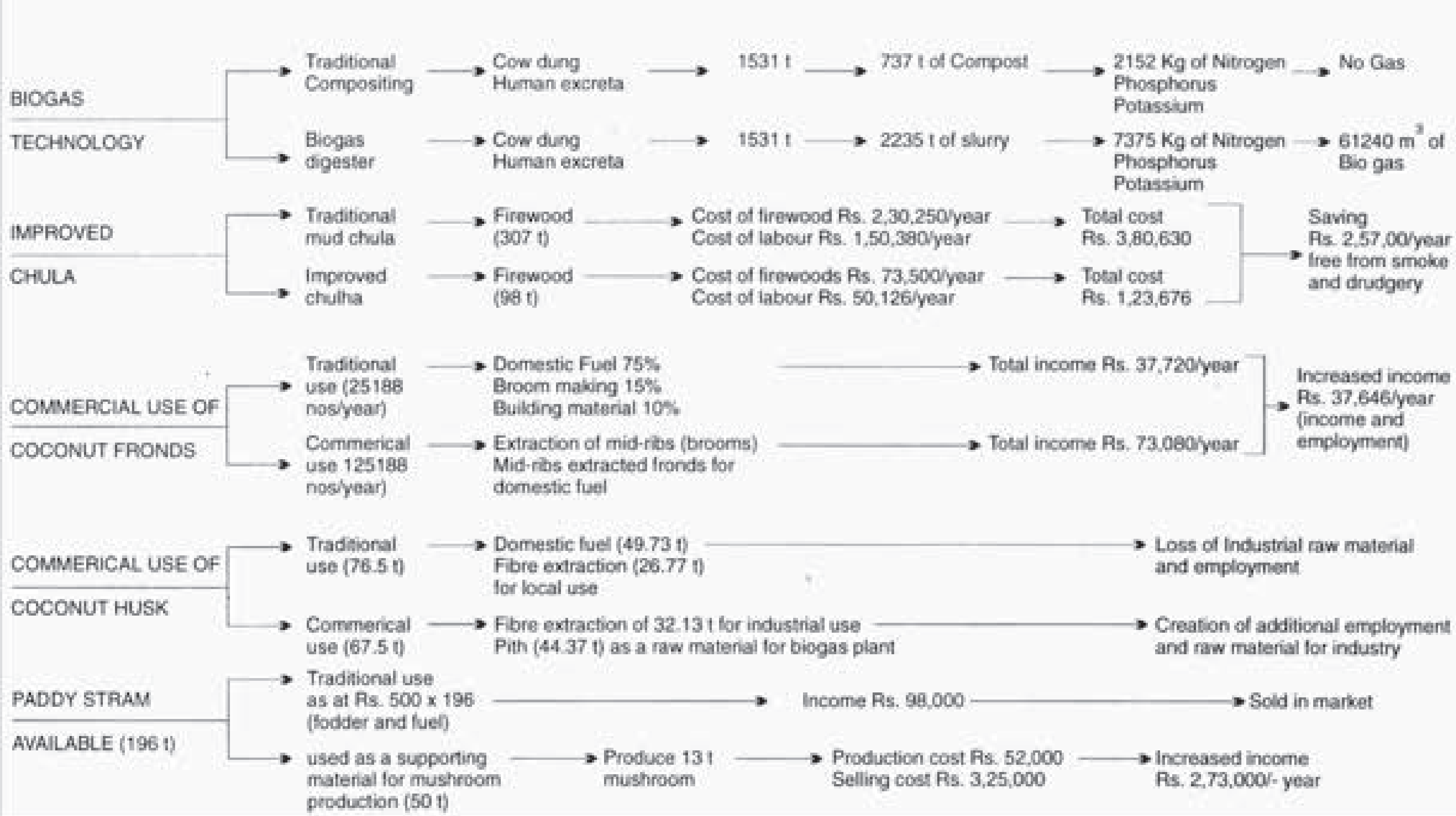
"We are still experiencing tremendous resource expansion as a result of the third technology cycle. We have entirely new materials in the form of ceramics, plastics and composites. And innovative methods of generating more electric power from a more diverse fuel base have at least for the moment, taken the edge off the energy crisis."

The power of technology to unlock resources will be even greater in the current technology revolution and singles out information technology and biotechnology as the embodiment of this cycle. Information technologies — centres on computers, communication and the microchip are already transforming the most basic function of society — food production, industrial production and human health services.

Use technologies now and now alone for better tomorrow particularly for rural India.


INTEGRATED REUSE OF WASTES FROM AGRICULTURE INDUSTRIES AND MUNICIPALATIES
Processing Centers
Combustible comercial waste
Combustible Industrial waste
Bulky refuse
Ordinary garbage
Night soil
Septic tank sludge
Live stock urine
Ordinary garbage
Livestock droppings
Bulky refuse
Hazardous materials
Recoverable refuse
Foul droppings
(1) Incineration plant
(including heat supply and generation facilities)
Compost residues
Residues
Steam
Re-cycled water
(2) Night soil treatment plant
Purified water
Dirty water
De watered sludge
Compost residues
(3) High-rate composting plant
Compost
(4) Shearing and separation plant
(5) Fowl droppings fermentation plant
Fertilizer dried fowl dropping
Land fill incombustibles
Storage Hazardous materials
Recovery iron
Recovy glass
Incinerator ash
Purified water
Landfill
Reservoir
Extra-high voltage sub-station
440 V
Effluent
Neighbouring facilities
Condensate
Steam
Green Houses 40000 m²
Steam
Training Centre
Water intake facilities

Valorization of Rural Wastes from Agriculture and Municipality - Manday Koppal Village



Prof (Dr) M P Chowdiah—a Brief Profile

Prof (Dr) M P Chowdiah, BE (Mechanical), MS, ME (Purdue, USA), Dr Eng, Dip in Admn (USA) is at present Professor Emeritus and Director, Centre for Agile Manufacturing & Research, University Visvesvaraya College of Engineering, Bangalore University, Bangalore.

Dr Chowdiah, who has dedicated himself to the cause of technical education, is a pious and popular teacher, and a dynamic leader in the field, with outstanding contribution in the areas of R&D and teaching at both the undergraduate and post-graduate levels both in India and abroad. He has an immense background of professional experience, which he gained while serving in several factories and industrial organizations at Bangalore and overseas. He was Project Engineer in the General Motor Corporation of USA, and Design & Development Engineer in Frimberger Company of USA. His extensive assignments in West Germany with FA Sening, N Fehrman and Company and the world reputed Fried-Krups Harburger Eison and Brozewerke enriched his engineering experience even more.

Dr Chowdiah's inventive research endeavours in the areas of metal casting, material science, machine tools, robotics, FMS, rural upliftment, etc, have won him many laurels worldwide. He has to his credit more than 360 research papers presented and published at national and international levels. He has been invited to present official exchange papers of India and deliver lectures at the international foundry, production engineering and numerous other conferences on several occasions in many countries. Besides several contributions to books and journals, he is a reputed author and editor, as also a member of several editorial committees. He is a member of executive council of several national and international professional societies such as the Institute of Indian Foundrymen, Indian Institute of Plant Engineers, Indian Society of Technical Education, American Society of Mechanical Engineers, American Foundrymen Society, Vereienn Deutscher Giessereifachleute (West Germany), etc.

Dr Chowdiah's vast experience in the field of engineering education has continuously bestowed on him several offices such as member of Senate, Syndicate, Academic Council and many other important committees of the Bangalore University. He was also Chairman I Member of Board of Studies and Examination Committees of Board of the various Universities, including those of Mysore, Gulbarga, Osmania, Sri Venkateshwara, Madras, Trivandrum, etc.

His research finding on "Thermo and Hydro-dynamics in Green Sand Mould Wall under High Temperature Gradient" has earned for him global recognition in the light of an original breakthrough which enabled elimination of common surface defects in casting hitherto not achieved.

With highly credited and recognized contributions in this field, he has been recipient of several National and International Awards. Yet other significant research achievements of Dr Chowdiah cover the fields of materials and metal casting; development of new CI alloy for sugar cane crushing rollers; casting of SG iron in permanent moulds and its wear mechanism; machine tools and production engineering; cold extrusion and upsetting of annealed SG iron; development of innovative and inventive new hybrid casting techniques which have all brought him to the forefront. He was honoured by The Institution of Engineers (India) as the Eminent Mechanical Engineer in 1991 and with the prestigious National Design Award in 1992.

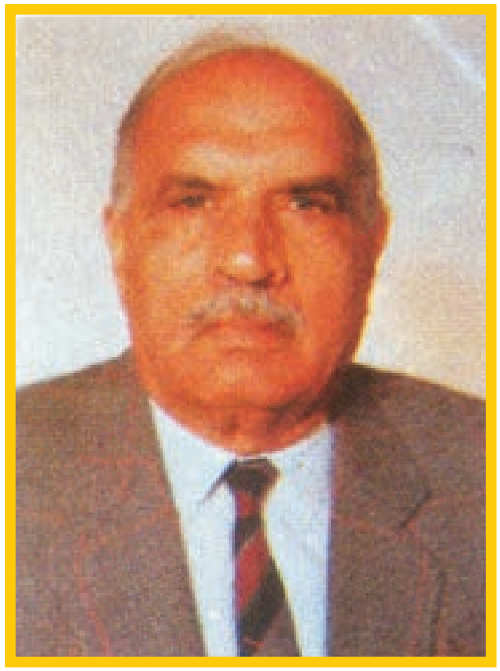
He has been very actively engaged in guiding more than 10 candidates for their Doctoral Dissertation in a wide variety of fields like material science, metal casting; agricultural engineering; design and development of gas turbine components and shrinkage fitted components for high speeds; in addition to more than 60 candidates guided for Masters' Degree in frontier areas of science and technology.

He has served as Visiting Professor at the Universities of Hiroshima (Japan), Hongkong, Australia, etc.

Dr Chowd iahs deep commitment to rural upliftment and the cause of the poor has been the creation of Centre for Technology Transfer for Rural Development in Mandya, Karnataka which has been rendering yeoman service in that direction.

As an engineer, researcher and teacher par excellence, Dr Chowdiah has had the distinction of being invited for various technical assignments throughout the world on numerous occasions.

Dr Chowdiah, was the Chairman of the Institution of Engineers (India), Karnataka State Centre, with which his devoted association in various official capacities had extended well over a decade. Earlier, he has served this Institution with unsurpassed dedication and distinction in the prestigious offices of Honorary Joint Secretary, Honorary Secretary, etc, which he was privileged to hold in continuous succession. During this period, he was wholly responsible for organising 125 major technical activities, out of which he was convenor for 47, as a result of which the Karnataka State Centre was highly recognized and rewarded as Centre of Excellence by the Council of the Institution. He has been elected thrice as Council Member (1989-2001).



Shri Jagman Singh
President 2000-01

Presidential Address

INTRODUCTION

I am extremely grateful to the members of the National Council of The Institution of Engineers (India) (IEI) for the great honour they have bestowed on me by electing me President of this premier professional body of engineers and technologists. I am acutely conscious of the heavy responsibilities that are associated with this trust and honour. I assure you all that I will do my best to meet your expectations and also to justify the confidence that has been reposed in me.

I take this opportunity to offer my sincere thanks to my predecessors for their noteworthy contributions in bringing this great Institution to its present status. I assure my predecessors, the members of the National Council and through them the entire engineering fraternity of the country that it will be my endeavour to further the cause of this Institution. I look forward to the active assistance and continued co-operation of my colleagues in the Council so that we may work as a cohesive force and add yet another year of achievements to the annals of the Institution.

It is my duty to convey my personal gratitude to the outgoing President Prof (Dr) M P Chowdiah, for his able stewardship which resulted in all round development of IEI.

THE INSTITUTION

Established in 1920 and incorporated by the Royal Charter in 1935, IEI has been working ceaselessly for the overall advancement of engineering sciences in the country which contributed immensely to national prosperity. At present, IEI has nearly 400000 Members out of which 80000 are Corporate Members. The membership of the Institution carries with it the pride of the profession. It has 95 State/Local Centres situated at various States' Capitals and also at the places where there is huge concentration of engineering activities. It operates 6 Overseas Chapters.

The IEI has bilateral relations with 18 professional societies abroad. It acts as a National Committee for the-World Energy Council (WEC), the World Mining Congress (WMC), the International Federation of Pre-stressed Concrete [Federation Internationale Du Beton (fib)] the World Federation of Engineering Organizations (WFEO), the Commonwealth Engineers' Council (CEC), and a Founder Member of Federation of Engineering Institutions of South and Central Asia (FEISCA).

The Institution is the premier Professional Organization of engineers, discipline-wise the most comprehensive having 15 engineering disciplines besides an interdisciplinary group. Different branches of engineering have become so much inter-dependent that growth of one discipline helps the growth of others and, therefore, engineers specializing in one branch get the opportunity to keep themselves abreast of the recent developments in other disciplines too.

To update the knowledge of professionals, IEI publishes journals in 15 disciplines of engineering besides an interdisciplinary journal and conducts various technical discourses such as lectures, continuing education courses, seminars and symposia, workshops, round tables, group discussions through its large network of State/Local Centres. The Institution also invites foreign experts during the International Congresses (that are organized by IEI) to the country so that the Indian engineers can interact with them for sharing their experiences and scientific knowledge.

The IEI has also started an Engineering Staff College of India at Hyderabad for providing in-service training to practising engineers. These training course are specially designed keeping in view the latest developments in the field, future requirements, trainees' acumen, etc.

The Institution plays an important role by providing interaction of budding engineers with engineers of repute. Listening to the vast experiences and knowledge from the seniors, they feel enthused and equip with technical knowledge to tackle the complex problems being faced by them.

I like to share with you some of my thoughts relating to the role of engineers in national development and some of the areas which need special attention in the 21 st Century.

KEY ELEMENTS OF FUTURE DEVELOPMENT

I want to dwell upon some of the key elements, namely, water, energy, environment which I believe are very much interconnected for the overall advancement of the country. Water Building dams and creating man-made lakes for the development of irrigation and hydropower are, no doubt, important activities. Equally important, however, is the proper and judicious use of precious water stored behind these dams keeping in view the requirements of the region with regard to crops patterns and also by adopting its most economical application and transportation techniques. I believe that time has come when the nation has to accept this precious flowing resource (both surface and ground water) as a national asset. We have to view the use of water from a wider vision and national perspective.

Bharat Ratna Sir Mokshagundam Visvesvaraya, the legendary figure in our history, worked ceaselessly throughout his life to bring fruits of advanced science and technology to the doorsteps of common man. In the field of expansion and development of irrigation, power and various other sectors of engineering including the engineering education in the country and also in the growth of this great professional body, names of a few eminent engineers, visionaries, planners and Past Presidents of lEI, namely, Sir R N Mookerjee (1920-'21), the Inaugural President; Shri Dildar Husain (1952-'53) ; Dr A N Khosla (1948-'49 & 1949-'50) ; Shri Kanwar Sain (1956-'57); Dr K L Rao (1958-'59 & 1959-'60); and Dr A Bhattacharya (1976-'77 & 1977-'78) come to my mind.

The nation cannot easily payoff the debt it owes to these great towering personalities in the engineering profession and the Past Presidents of the Institution. The generation will, no doubt, remember them as the harbingers of 'Irrigation and Hydro-Electric Project Revolution' in the country. They did what was essential to do at that time-promoted economic prosperity and thus strengthened the roots of independence and democracy.

I would like to mention here that about 30 years ago, Dr K L Rao propounded the concept of integrating the rivers of India into a National Water Grid. He prepared a scheme for linking the Ganga river with the Kaveri which was then described as uneconomical and technically unfeasible. Although keenly conscious of difficult terrain and treacherous mountains of the Himalayas through which the Ganga water was to travel and the enormous cost it involved, he worked out the multiple benefits which would flow from the scheme. Unfortunately it evoked sharp criticism from almost all political parties. Lack of vision, political will and regional pulls and priorities put an end to the whole idea.

But ideas, like memoirs, do not perish, though souvenirs perish. Now the National Water Development Agency (NWDA) has estimated that the total cost of interlinking river basins of both the Himalayan and peninsular components for the dual purpose of creating inland waterways and irrigation facilities would be around Rs 3310000 million. This figure may go up 3-4 times higher if we consider completion period as 50 years. The budgeted amount (on an average) for the country as a whole is around Rs 150000 million.

Dr M S Swaminathan's dream of Green Revolution, became a reality because water and power— the two main ingredients for this revolution — were readily available. He realized that importing food was like importing unemployment. By doing so, we were supporting farmers in other countries at the cost of 70% of our people engaged in agriculture. He is currently engaged in the conjunctive use of saline and sweet water. He is also working on genetic engineering which will yield new types of crops and fruits consistent with the application of mixing of saline and sweet water. This will act with a friendly reaction to the new seeds hitherto unknown to us. It will be a spectacular breakthrough as and when it comes. Sadly, there are a few people who are engaged in R&D activity. I wish their voices were louder.

Recognizing the urgent need for harnessing the vast water resources in an integrated manner, we therefore, strongly recommend to the government to consider seriously the reformulation of 'National Policy on Water' so that we are able to feed millions of hungry mouths. To achieve this, both the Governments (Centre and States) must arrive at a consensus for amending the constitution, if need be, in order to provide water the status of a national subject and not a state one. Water resources have to be given an utmost priority in the scheme of things in the 21 st Century.

Many irrigation and hydro-electric power projects are languishing due to reasons like inter-state water disputes, paucity of funds, etc. This enormous delay causes colossal loss of revenue in terms of loss of power generation and agricultural production possibilities. The most distressing aspect of these projects is our near failure to rehabilitate the displaced persons. Our work in this regard is far from speedy or satisfactory. At times, the insensitiveness of the government in this matter is severely resented.

I believe that the rehabilitation programme should receive top priority and be considered as a National Issue. Earlier, in 1947 when millions of homeless people came to India from across the border, the then Government acted with marvellous efficiency and speed. The quick rehabilitation of those displaced; persons was doubtlessly one of the greatest achievements of the then government. However, in subsequent cases, largely pertaining to the oustees from dam sites, same promptness, efficiency or even sympathy has been lacking.

We have to realize that a man, by nature, has inertia. He will not move unless he is made to do so. We have to view this complex problem from the trauma people face when uprooted from their ancestral homes and forced to live in what is, often, unproductive and alien land where they know nobody and they do not even speak their language.

Needless to say that the local indifference has been the root cause of this problem. The government should seek greater public participation from the very inception of a project in so far as rehabilitation problem is concerned. The government should take more effective, judicious, and humanitarian measures. The history of past few decades shows that the measures adopted by the government have not benefited either the oustees, potential oustees or indeed those in drought-prone areas who are likely to benefit from the proposed dam. The nation should address itself to the rehabilitation problem.

The union government should evolve a 'National Rehabilitation Policy' for persons displaced by hydro-projects based upon recognizing the legitimate socio-economic aspirations of the people of the area affected and establish result-oriented, responsive and generous management to implement the policy decisively, both at the national as well as state levels.

Such a policy, we feel, apart from giving appropriate compensation for the loss of property, should include programme of giving on-the-job training to children of the oustees compatible with the requirement of workforce on the project. They would, thus, make contributions towards its construction and also take pride in it. Necessary financial provision needs to be made in the project estimate itself. Further, small-scale industries, keeping in view the skills and education available, be established besides industrial training and educational institutions.

The existing 'absurd approach' to the misery and problems of the dam oustees needs to be replaced by one based on human touch, empathy and generosity.

Energy

The installed capacity of power generation in the country at the end of the Eighth Five year Plan was around 85000 MW. It is visualized that a total capacity addition of nearly 140000 MW would be attempted in the next 15 years or so (ie, upto 2012). The Ninth Five-year Plan envisages generation capacity addition of about 40000 MW. To develop the necessary transmission and distribution systems, investment of nearly Rs 1700000 million in the next two decades or so shall be required.

Recognizing the key role of energy (ie, power, oil and gas) in accelerating the economic growth of our country, we will have to disturb the nature from its slumber of millions of years by drilling and blasting through its belly, boring through it by means of environment-friendly tunnel boring machines (TBMs); diverting the course of rivers accustomed to flow in a certain pattern since time immemorial, going far-flung and inaccessible places deep into the mountains to tap vast potential of hydro-power. The Himalayas present a veritable gold mine in the form of cheap hydro power. The prosperity of the Scandinavian countries is substantially based on hydro power. Our oilers and drillers, will have to traverse through hazardous terrains, jungles, mountains, marshy places and rivers, and will have to face the biting cold winds. Engineers and technicians engaged in the generation of power—hydel, oil, gas, or thermal—will remain, as in the past, exposed to all sorts of danger to life and equipment, Oil is expected to remain the world's most important energy source. We have to continue more vigorously deep sea explorations and development initiatives. In the developing countries, like India, use of oil for transportation increases more rapidly than in the industrialized countries. We visualize natural gas as a fast growing primary energy source in the next 25 years. Gas is becoming the fuel of choice for new electricity generation worldwide, primarily because combined-cycle gas turbine plants are less expensive to build and more efficient to run than other means of power generation. What was installed to cover the peak load is now found suitable for base load. It is cleaner fuel than oil or coal and not as controversial as the nuclear power is. The use of coal on world wide basis will also increase at an average rate of 1.6%per year. But, in India its use will be almost double by 2025 or so. The total recoverable reserves of coal around the world are estimated at 1088 billion tons, enough to last 200 years or so out of which India's reserve is around 100 billion tons. Between 1996-2020, coal use for electricity generation in India is projected to rise by 3%per year. India is expected to increase its consumption of electricity at 4.9% average annual rate from 1996 to 2020. In future years, coal will face tough challenge as far as environmental pollution is concerned. Increased concern about the harmful environmental impacts associated with coal has taken a toll in coal demand throughout industrialized areas. Coal combustion produces several air pollutants, particularly sulphur dioxide that adversely effects ground-level air quality.

In the coming decades, global environmental issues can significantly affect patterns of energy use around the world. The principal international energy issues revolve around supply interruptions and their implications for energy security, price stability and impact of energy production and computation on regional and global environments. Often, regional and global environmental goals are in conflict. For example, nuclear or hydropower projects may be opposed within a given country, while on a global scale they lessen the emissions of carbon dioxide—the principal green house gas.

Energy consumption worldwide will increase by about 65% by 2020 as compared to the 1996 consumption out of which more than half the increase will be in developing countries.

As such we should tap deep seas, deeper sands and coal beds. But we will not surrender. We cannot remain complacent to the needs of mankind. We have to have knowledge, energy and technology to solve the environmental ills facing our planet.

Environment

Our planet-earth has limited capacity to absorb or assimilate and, therefore, we, cannot afford to make excessive demands on the environment. Engineering profession fully understands that wealth and economic development stem from the resources of the earth. We fully recognize that in the long run, depletion of water resources, coal deposits and oil, reduction of bio-diversity, disruption of eco-systems and climate change will have disastrous consequences for all us wherever we live.

The environmental issues today are as diverse as they are serious. Since the industrial revolution, we have consumed vast quantities of fossil fuels and other resources that require extremely long periods of time to accumulate, and have produced waste in quantities greater than can be absorbed by natural eco-syste. Technology has been a major source of economic inequality among nations and among communities. We have to make technology an ally in the quest of social, gender and economic equality. In most cases, the daily life and economic base of developing regions largely depend upon natural resources such as forests, soil and water. Strangely many of the efforts to combat poverty, hunger, disease and illiteracy inevitably result in the destruction of nature. Such depletion of natural resources cause deterioration of living conditions, further aggravated by the effects of population growth and urbanization. In the midst of socio-economic globalization, all these problems are inter-connected, and environmental damage is becoming even more complex and serious.

The production and use of energy is the leading source of humanity's greenhouse gas emissions. The combustion of coal, oil and natural gas accounts for roughly three quarters of all carbon dioxide emissions. Fossil fuels emit almost one-fifth of all humanity's methane, some carbon dioxide, and large quantities of carbon monoxide and other air pollutants. The industrial sector accounts for more than one-third of the global CO_2 emissions from fossil-fuel combustion (excluding the power generating sector), the residential and commercial sector 32%, and the transport sector a bit over 21% (and growing rapidly). These energy-related emissions could significantly be reduced through a combination of new technologies and policies. Leaks and spills during the extraction and transport of fossil fuels can be minimized. New 'integrated recovery' techniques can cut methane emissions from coal mines by nearly 80%-90% as compared to standard practices. Technologies available today can reduce methane emissions from natural-gas distribution systems by nearly 80% (as compared to the world average). In oil fields where natural gas is flared off or vented (because its sale is uneconomic), small on-site power generators can be introduced to make electricity for local use, or the gas can be compressed or converted for use by transport or near-by industries. These and many other technologies could together reduce total fugitive emissions from energy extraction and fuel transport by 50%-90%.

We must learn to live in harmony with nature. In developing regions, especially in India, the first priority, in our opinion, should be to provide sustainable livelihoods by increasing funding, creating employment opportunities, eradicating poverty and encouraging policy-making that give due attention to the socially disadvantaged by enhancing technology transfer and development; and also by strengthening the development of human resources.

The United Nations Conference on Human Environment, held at Stockholm in June 1972, was an eye opener to the developed as well as the developing countries to discover the fragilities of our natural systems. Twenty years later, the United Nations' Conference on Environment and Development (UNCED), held at Rio in June 1992, evolved the Agenda 21 for human development in an environment-friendly manner. This long journey was from 'awareness -'I creation to' 'action programme'. The Action programme aims at preparing the world for the challenges of the next century. Every country has to motivate its professional groups to offer their support. IEI does so through one of its peripheral bodies namely the Sustainable Development Forum.

Taking cognizance of environmental issues in the fast growing industrialization scenario, IEI has recently started the Sustainable Development Forum;'and organized a World Congress on 'Sustainable Development — Engineering and Technological Challenges of 21st Century,' during January 20-23, 2000 at Calcutta. This programme was supported by both the Government of India and the Government of West Bengal.

The Congress focussed on interactive studies to identify key global issues and concerns that would help chart out strategies to meet the challenges through involvement of engineers and technologists in a sustainable manner. A number of options were discussed that can help to fulfil the needs of the present without compromising the ability of future generations.

We will use, as in the past, our ingenuity, imagination, wisdom and knowledge towards innovations and development of environment-friendly techniques and equipment so that we do not adversely disturb the equilibrium of nature in the exploitation of its resources which are surely meant for the benefit of mankind. We, therefore, have to continue our R&D work vigorously and relentlessly to develop complementary methods and techniques so that we can achieve our desired goal. Our aim will be to launch sustained campaign to protect our environmental assets at the micro level. We will direct our efforts and knowledge in providing irrigation and power and in moving the wheel of industry at no ecological risk to achieve the desired social goals speedily and economically. We all strive hard to produce technology and ecology of hope and not of despair.

'We need environmentalist who could show how to 'do' rather than merely say 'do not do' — an evergreen revolution on the farms leading to productive and sustainable farming systems and happy farming families', says Dr M S Swaminathan, father of India's 'Green Revolution'. A similar approach is needed in the field of energy production and irrigation too.

Environmentalists, quite often, can be wrong in their predictions. Senator George Mitchell, in his book 'World on Fire (1991)' presented his doomsday scenario that the world would be two or three times as much warm as it is today. Now researchers say that the earth is likely to warm by about 1.8°C during the 21st century. Many scientists believe that the food production will increase because winters will be milder and crop growing seasons longer.

The expected increase in CO_2 levels due to burning of fossil fuels could create a 'plant heaven'. CO_2 acts as a fertilizer for plants. More than a thousand experiments with food crops in 29 countries show that doubling the world's CO_2 would raise crop yields by half. And with increased CO_2, forests all over the world should be more robust, allowing them to support more wildlife. If temperatures warm a few degrees, there will be more moisture in the air, more snowfall, more polar ice.

We shall continue making sustained efforts with utmost zeal and motivation to execute developmental projects with eco-friendly techniques, materials and equipment. We will take the problem as a challenge and attempts be made to convert it into an opportunity.

To achieve this aim, we seek co-operation amongst the scientists, technologists, engineers and the body politic. We will involve the public to reassess their roles and purpose on the globe-their priorities and their reactions to those already in distress and those on the sharp edge of disaster. But we will not lose hope. We will not remain impervious in an ever changing world.

INDUSTRIALIZATION

During the five decades of post-independence era, our industrial policy and construction industry had largely been characterized by centralized planning and government control. This era, started under the leadership of Prime Minister Jawaharlal Nehru, witnessed spectacular advances in the optimum exploitation of natural resources. In order to effect massive industrialization of the country, Nehru created organizations to establish and handle steel plants, fertilizer plants and atomic power plants. Gigantic hydro-electric projects like the mighty Bhakra Dam, the modern temple of resurgent India, was planned and executed. Even foreign dignitaries were amazed at the splendid quality of work on the massive concrete structure at Bhakra Dam. Imbued with patriotism, Nehru was eager to develop the country at a very fast pace.

Nehru was convinced that India could progress economically only by adopting planning that would make best use of modern science and technology. Unfortunately the efficient and result-oriented concept of 'public sector' manned by competent and dedicated personnel, administrators, engineers and technicians, started showing discernible cracks, as is true of great kingdoms and civilizations.

It is not my intention to go into the causes which led to the failure of the policy of planned economy and growth on socialistic pattern. The nation, in its collective wisdom, felt the need for relaxing or removing controls responsible for retarding country's progress and economy and to usher in an era of liberalization and reforms. The new policy, popularly known as 'Globalization', and 'Liberalization' aims to consolidate further the gains on the industrial front already made and also correct whatever weaknesses it had. The new policy stresses on competitiveness, perhaps an ingredient not exposed in the earlier industrial policy structure, efficiency, technology and manpower upgradation and capacity utilization. Globalization, in true sense and word, means that the successful management of tomorrow be globally competitive, sell its products and service world-wide and be in totality more responsive to the changing demand patterns of the market it services. Our products have to be more competitive in the global market in terms of both quality and cost. Research and Development (R&D)has to be more innovative and close 'research institution'— 'industry' linkages have to be developed and maintained to fend off technological obsolescence. Truely speaking, only those organizations that have celarcut aim, a strong R&D programme, and global acceptance will survive.

We have a few observations on the state of research 'Infrastructure' in the country. Human component, an important element in the R & D, is suffering because the cream of national talent goes abroad since we cannot ensure them job opportunities to complement their expectations. Further, they try to go in more lucrative cadre of services like IFS and IAS. For research funding to be truly efficacious, we must have the best people, best material infrastructure in terms of buildings, laboratories, instruments and minimal paper work.

I strongly urge that the Indian Industry should come forward in establishing their own R&D centres instead of depending upon the centres which are under the aegis of the government. In strategic areas, however, like defence, space or agriculture, government research can be effective since no competition is there on these fronts. When the industry is competitive, global and outward-looking only, then the products can be acceptable in the market. Viability of R&D can be ensured only through increased funding from the industries.

Despite flourishing, Indian industries will continue to play a secondary role to multinational companies. They may be excellent generic manufacturers but are still not in the vanguard of drug discovery. As someone said: 'We can have the husk of everything for money, but not the kernel.' R&D endeavours lack motivation as the management controls are in foreign hands. But the multinational companies (MNCs) cannot be expected to possess national fidelity.

But this opening-up throws both challenges and prospects to the engineering fraternity. All policies, howsoever, alluring and seemingly productive, have certain pitfalls. Globalization is no exception to this. Our endeavour should be to see that the policy of liberalization does not lead to increasing divergence in the development process at the regional level. We have to be careful that inter-state inequalities in per capita income and labour productivity do not increase, including the gap between the agriculture and the non-agriculture sectors. The country has to see that this new policy opens up new opportunities for sustained growth and development and at the same time does not open up . new market or remove control over domestic agriculture, industry and services. We have also to guard against the growing phenomenon of social disintegration taking place in states. A substantial increase in the unemployment rate, distorted farm and non-farm sector ratios are likely to have serious social, cultural and political implications.

Idea of upgrading technology must be encouraged. We should encourage foreign direct investment (FDI) in core sectors and discourage inflows in non-priority areas. Our country needs the latest technology in all disciplines. But we do feel that indiscriminate induction of imported technology is likely to affect our own R&D efforts adversely because man by nature, takes the path of least resistance. This policy tends to, some extent, deflate our efforts to display ingenuity, vision and common sense in evolving a system and approach, relevant to our industry.

In its quest for global competitiveness, Indian industry can buy the latest technology from abroad, but its real competitive edge can only come from its own home-grown advantages. The key to all growth is experiment with new ideas, acquiring experience and its spreading down to the earth in a continuous and endless process. Areas where high technology is required need to be, therefore, identified and quantified.

Challenges stir our inner talents. These spur us to be more imaginative and determined. Setbacks ignite our thinking. Challenges and responsibilities bring out the best in human nature.

'Apni asliat se ho aagah aye ghajil ke tu
Qatra hai lekin missale be hare be payaan bhi hai
Kyon griftaare tilsme haich miqdaari hai tu
Dekh to poshida tujh mein shakukate tujan bhi hai.'

[Know yourself, discover yourself. You are like a drop of a bottomless ocean. Why are you in the grip of magic of inferiority complex? Behold, hidden in you is the grandeur of tempest]

Let us inculate this temper of incessant striving. not withstanding initial failures or reverses.

Construction Industry

Construction industry undoubtedly is the backone and a propelling force behind our progress. It has the potential to contribute to people's lives in many ways. This needs high skill. dynamic leadership, broad vision. great courage. latest technology and communication system. Here sound and independent decisions are needed. unlike the usual commercial practices in other types of projects. Our construction agencies, including around a dozen top ones, have not, in my humble opinion, yet acquired necessary technical expertise and efficient professional management required for today's highly complex works of large magnitude and intricate nature that our counterparts in foreign countries possess. There appears to be big gaps and our construction organizations must, therefore, move fast not only to bridge those gaps but also to acquire rapidly their level of efficiency and performance. I am confident that the 21st Century is poised to witness efficient, quality-oriented and eco-friendly building techniques. 'High-rise movement' is in the offing. Population explosion along with the shrinkage of land has already changed the direction of development needle from horizontal to vertical. The only alternative is 'sky', leading to springing up of sky scrapers all over the world. The 102 storied Empire State Building (inaugurated in 1929), could have been one's dream but today high-rise structures have become a necessity. Kuala Lumpur has the world's tallest twin towers — 1483 ft high. This concept of going into sky will give birth to high technology in 'seismic and soil mechanics' disciplines so that correct and dependable forces can be computed for the safety of the structures. It will usher into the era of use of lightweight materials. Recycling will gain momentum as we develop materials that are easier to reuse. We predict that civil engineers and architects will increasingly rely on new types of foamed glass that can be made unusually strong but still light-weight. Glass is a very recyclable material made from sand, and it can be crushed back essentially into sand. We could see foamed glass replace much of concrete in today's building. Scientists are working towards genetic engineering corn plants with the kind of fibre content that paper companies would find attractive. So long as genetic engineering possess no ecological threat, this approach could tap into a huge stream of agriculture waste, turning some of it into an industrial ingredient. 'We visualize that through the engineering process of recycling and modern alchemy, we will, in this century, move more swiftly towards a world without waste', says Ivan Amato, the author of the Stuff: The Materials the World is Made. New thoughts and concepts on safety, fire protection devices and systems, positioning of elevators fitted with automatic rescue devices, safe exit routes and escape stairs, etc shall throw challenges to us all. Use of modern construction equipment and techniques such as Ready Mix Concrete (RMC), super-plasticizers, high capacity concrete pumps, sophisticated form-work systems (such as slip form, hydraulic jump forms), technique of placing concrete with distributor booms mounted on erection cross, on tubular column and on the turn table of tower cranes, capable of handling long horizontal radians 50 m or so, high capacity (8 m^3) transit mixers, application of 'Belt-Cretes' for fast movement of concrete, etc will be essential pre-requisites for the building of high structures. This would also lead to production of aggregate and sand of good quality with laboratories to test the grading and quality of aggregate and sand. The processing plants will work under eco-friendly conditions with no dust flying in the atmosphere. These and other allied measures need serious consideration in the 21st century.

We also visualize that after 40 years or so, we will almost live in the sky. An architect's vision of a house may be in the form of a big RCC column (40-60 ft dial through which a small lift will operate and shall lead to cantilever branches at various levels on which one or two room houses would be built.

In the construction of bridges, we visualize that in the 21 st Century cement and steel would be, to a great extent, substituted with strong and light-weight materials consisting of glass and graphite fibres in a polymer matrix, equipped with electronic and optical sensors that would warn engineers of any potential structural problems.

This century we believe shall also witness a sea-change in the living style of mankind. With the invention of new construction materials, problems seemingly beyond solution today, shall be solved. There are bright chances that reinforcing coal mine roofs with rejected steel ropes will increase the life of coal mines by 10-20 years, besides almost doubling recovery rate in case of normal mining and help miners extract coal from thicker layers. Recycling of rejected material is another significant aspect of this innovation.

National Tunnelling Corporation

To ensure supply systems to meet the rapidly increasing demand of water and power; to develop efficient rail-based mass transport systems in metro cities; to execute storm drainage and sewerage systems; and numerous other utility activities, we shall be undertaking construction of hundreds of miles of tunnelling at surge shafts underground in the 21st century. We will witness 'tunnelling' as an important activity behind the development of projects and in creating eco-friendly working atmosphere. Today tunnelling is a highly specialized job and requires advanced and complex technology hitherto unknown to the country. Applications of tunnel boring machines (TBMs), particularly techniques of subaqueous shield tunnelling using either the 'earth pressure balance (EPB) system' or slurry system or the fluid balance system which combines the best features of both the systems making the machine most versatile which can be used in many different geology settings, deep braced cuttings, special ground treatment measures, incremental launching of girders, pre-injection techniques in highly sheared zones, though not limited to these are some of the techniques this century is poised to witness.

Realizing the magnitude of tunnelling required in the next 50 years or so in all disciplines of engineering activities and more importantly. with a view to pooling the widely scattered expertise and utilizing more effectively 'men and machines' under one 'umbrella'. we strongly urge the government to institute a 'National Tunnelling Corporation.' With this kind of set-up. we shall be then able to utilize the vast experience and knowledge gained by us and further disseminate it amongst a larger section of engineers instead of letting it confined to a particular organization or allowing it to rust out on the completion of a project in a particular zone.

I take this opportunity of sharing a few observations with you all here. We are all aware of the pathetic and unfriendly ecological working conditions obtaining at most of the construction sites. We observe the workforce working without elementary safety devices, such as, safety shoes, safety hats, safety belts, welding goggles, welding aprons, safety masks, protection against noise — pollution, etc. We also observe men and women working on the building of highways and roads with hand brushes cleaning the surface of road while squatting and spraying molten coal-tar and asphalt with legs wrapped in torn gunny bags without hand gloves, safety glasses, 'safety shoes, aprons, etc. We also witness treacherous wooden scaffoldings with tremulous and worn-out wooden planks resting on it. Outdated and primitive method of transporting concrete on heads is both laborious and against the fundamental principles of 'mechanics'. This, I feel, needs to be stopped. Living conditions of the labour — inhuman and pitiable as these are — need our special attention. We must create a healthy environment conducive to better performance and efficiency. We, therefore, strongly urge the management to provide necessary safety equipment and reasonable accommodation with provision of drinking water and hygienic living conditions. These should not only form, an integral part of the contract, but be also fully implemented by both the parties, the contractor and the client. A satisfied and happy workforce will surely make greater contribution to the job.

We are successfully launching missiles and sending rockets in space. We have made spectacular technological developments. We have joined the community of nuclear powers. We are all justly proud of these and other achievements in scientific and technological fields. However, we have failed to do seemingly small things: drinking water, medical aid, a small hut to live, safety gadgets to mention a few only. Surely our workers deserve a better treatment. Our approach needs. besides professional ethics. human touch too.

Arsh kay rehnai walo, arsn ki
battein na karo,
Hum zamiin kay bandein hain,
Zamin ki battein karo.

Let us recognize that it is the skill of our artisans, welders, masons, carpenters, painters, machine operators which lends grandeur to the structure. They shape metal so real they seem to breathe. They carve cold marble until it almost comes to life.

Our slogan in the construction industry should be 'Safety-Quality-Ecology — Produce or Perish'.

The entire construction industry in the country has to assess collectively its strength as well as its weakness and deliberate on the needs of the future.

RURAL DEVELOPMENT

The application of modern technology is the key to the upliftment and economic prosperity of a major section of population living in the rural areas. But the technology used has to be eco-friendly, relevant and appropriate and it should also make use of available resources without upsetting the traditional rural setting.

We see an aeroplane, a sign of progress and power, zooming in air and also a bullock-cart dragging and shrieking leisurely in a slushy and deeply-rutted Kachcha road. If an aeroplane needs a good weather to fly so a bullock-cart needs a smooth road to ply. Our technology should give farmer a sturdy bullock-cart of light weight and with reduced friction and its carriage scientifically constructed and balanced as we do in the design of an automobile so that we put minimum load on the neck of its propelling force — 'The Bull'.

In far-flung and inaccessible villages, people, still use Kolhu one of the most ancient machine known in history. It is an oil grinder made of wood and operated by a heavy and long wooden lever not easy to operate. Engineers can look into this problem by providing a light weight handle powering a 'Bevel Gear and Pinion' gear device housed in bearings so that even a child could easily operate it. As and when electricity comes, it can be converted into small electric drive or in its absence one can use a 4-5 HP diesel engine to drive the grinder to have more production per hour. We should also think of modernizing the traditional spinning wheel which may have 4 to 5 spindles, so that production increases proportionately.

Let us think of small things as these have an enormous impact on our economy and quality of life. If we all contemplate doing infinity instead of fixing drains, most of us will die of cholera.

Imported and indigenous technologies should be, blended together consistent with the existing conditions in such a manner that the final product eradicates poverty, ignorance, disease, inequality of opportunity, and provides basic human requirements such as drinking water, roads, medical care, education, etc. The institution can offer a great deal in finding solutions to these problems.

National priority in rural development sector is obviously on ensuring income generation and employment generation activities for the poor people in rural and remote areas. Currently, about 70% of the Indian population resides in rural areas; and in years to come, the urban migration is expected to be so intense that the proportion of urban population will surpass rural population. Whereas it provides an opportunity for the national planners to plan activities in the rural areas. For a controlled absolute number of people, it will also cause serious concern in the urban areas where unplanned growth will result in excessive pressure on urban infrastructure and civic amenities. In other words that will be carrying the urban infrastructure beyond its carrying capacity. Such a situation can create havoc in the urban areas. Therefore, government has to look out for activities that will promote larger opportunities of income generation and employment in the rural areas. The foremost of these will be activities of value addition to agro-products. This sector is normally low capital requiring but high employment generating.

This will call for intense intervention from the engineering community to develop and disseminate technologies and techniques that will support programmes in the rural areas by' utilizing local natural resources. This will also call for focus on upgradation of traditional technologies in use. Such an approach will improve productivity of equipment thereby giving better returns to the rural poor. This will really mean developing technologies for the masses, where they benefit from modern knowledge and information and continue to benefit from the existing natural local resources.

The Rural Development Forum of IEI will have to identity certain activities (like food processing; metalcraft; wood craft; pottery, tannery, handlooms (textiles) and make an in-depth study towards the possibility of improving productivities and effective options of absorbing the state-of-the-art technologies and techniques. Depending on the natural resources and the skills of local people, the RDF will have to develop projects that would attract funding from government and other agencies. Subsequently, this Forum needs to have its own manpower to provide technical back-up support to the beneficiaries. The major activity here will involve identification of the problems of engineering nature and finding out suitable funding for the same. These projects will have to be operated successfully and results documented as 'best practices'.

KNOWLEDGE REVOLUTION IN THE 21ST CENTURY

What makes a country worthwhile to live is not the majestic buildings, or the invincible forts, or the magnificent temples of awesome antiquity or the vast rivers or high mountains. It is the people and the spirit that reside in them which make a country strong and great.

'Nations have passed away and left no traces,
and history gives the naked cause of it.
One single, simple reason in all cases,
they fell because their people were not fit'.

And one essential requisite that makes people great and enable them to overcome obstacles and make progress in the desired directions is knowledge. I believe that ambition without knowledge is like having a boat in dry land.

It is, therefore, very essential for professionals to keep themselves abreast of the latest developments and innovations going around the world in their respective disciplines.

College education is only a stepping stone. Securing a degree is neither adequate nor the end of the road. There should be life-long quest for more ideas, more knowledge, more challenges, more of every thing. Shakespeare who left the world 154 precious and incomparable sonnets and 58 plays did not go to Oxford or Cambridge. He was, in fact, a wide reader with an inquisitive mind and confidence in his own perception.

Recognizing the importance of knowledge, IEI has opened an Engineering Staff College of India (ESCI) and is also in the process of providing more avenues and forums so that our engineers acquire necessary expertise and disseminate the same in industry, government departments, private and public sectors, and farming community. IEI is the largest open university in the world producing nearly 3500 engineers every year through non-formal mode of education. This is undoubtedly one of the most noteworthy national service the Institution has been providing since 1928, and of which the members can justly be proud of. The Institution has been offering coaching classes to candidates appearing at the AMIE Examinations.

In the field of continuing education in engineering and related subjects, a good landmark was the establishment of Engineering Staff College of India (ESCI) at Hyderabad in 1981. Our endeavour will be, as in the past, to develop the ESCI as an International Centre of Excellence for continuing education in engineering.

To enlarge the scope of its role in imparting technical education, the Institution has already started post-graduate level courses so as to equip the engineers to face the newer demands and challenges. IEI will also make efforts to bring into its fold the vast number of engineers with diplomas and enable them to play an effective role and have appropriate status in the Institution.

The world has now moved into the new millennium and the cyber age. The information technology clubbed with the web-centric world of internet, space age communication, virtual reality, video conferencing, and E-commerce have now become a reality. Information technology has now pervaded into all spheres of human activities and has become the moving force behind all technological developments. India's emergence in the cyber age has not been a natural process of evolution through a strong user base of information technology. In fact, a strong base is still in the process of development. What has propelled India to emerge in the cyber age as a force to be reckoned with is its impressive array of qualified software personnel. Recognizing the importance of this science and to educate the society as well as the engineering fraternity, IEI appropriately chose a central theme of National Importance, 'India's Emergence with Cyber Age' on the occasion of one hundred and thirty eighth birthday of Sir Visveswaraya (which is celebrated as Engineers' Day). This theme was discussed and debated throughout the country by all the State/Local Centres of lEI. Indian software developers have already registered their presence in the world software scenario. The goal is laudable and the path may also be right, but the journey may not be smooth unless it is taken up to design and manufacture, instead of just manufacturing to the design of others. India needs to develop a strong user base of 'information technology' which is a pre-requisite for a software superpower. India has yet to build up a strong infrastructure for communication and software development. All sections of the society — industry, trade, agriculture and government departments — are yet to use Information Technology (IT) widely. Indian software developers should concentrate more on off-shore development of total packages rather than on software coding jobs carried out on site. It has rightly been said that 'Information Technology' is 'India Tomorrow'. With a target of information technology for all by 2008 AD and a software export target of $50 billion by the same period, India is slowly but surely moving towards becoming a software super power.

Never before has there been so many changes and so quickly as in the field of electronic communication. We have to explore newer ways and means of further utilizing our existing technical resources. We had Green Revolution.

We are striving to have Blue Revolution and White Revolution. Let the 21 st Century witness "Knowledge Revolution" for other revolutions shall automatically follow in quick succession. IEI will spare no efforts in creating "Knowledge Revolution" for the benefit of mankind. The aim in the early part of 21st century should be the initiation and spread of "Knowledge and Skill" revolution for ending economic and gender inequality.

THE CHALLENGE OF BRAIN DRAIN

The national support for building excellence in the engineering faculty resulted in setting up centres of excellence in terms of IITs, IISc and a number of engineering colleges around the country. The state governments and central and state universities also supported this infrastructure to add to the number of engineering students. Whereas the eighties witness a greater demand for people from the engineering faculties; and new infrastructures in the engineering sectors were created with a thrust on Research, Development and Demonstration; the nineties saw steep fall in allocation of funds for such institutions of high learning in engineering sector. Two basic factors contributed to this. The first was the government's shift in the education sector from higher education to primary education; and opening up of the economy requiring personnel with management background and experience. The other factor was that the entry of multinational corporation on the Indian scene led to a sudden spurt in salaries and perks for persons with management background. This led to a large number of engineering students opting for post graduate courses in management and then going for managerial jobs. Whereas the advent of foreign companies has boosted the national economy, it has also created atmosphere where local creativity has totally been strangulated. Designs, standards, techniques and production technologies were totally transferred from the parent companies and it is supposed that the local engineering personnel have no role, except for managing the show. This has now created an environment where engineering talent opting for research and development has come to a standstill in most of the institutions and R&D laboratories.

The engineering sector is faced with two kinds of brain drain and these are:

(i) brain drain of bright and outstanding engineering graduates and post graduates to research institutions and the industries outside the country, and

(ii) brain drain of engineering students to management activities and administrative practices within the country.

Both these kinds of brain drain are indicative of wastage of national resources (both public as well as private). This has resulted in steep deterioration in the quality of .engineering personnel now available for employment. As against this, the global competitiveness calls for better quality of brighter engineers.

It is now necessary that this brain drain (both external as well as internal) is effectively curtailed in the engineering sector. One could say that every individual has the freedom to opt for a career that will give better returns. No one can challenge that right of an individual. What is necessary is only to make sure that the scarce national resources for engineering education are effectively utilized.

It is necessary to provide options for management studies at the undergraduate level or to provide restrictions on engineering graduates to shift from engineering sector after completion of their studies. The other important aspect is to focus on continuing education and distance education. This will also involve on-the-job skill improvement, the development in the industry and the government sector. IEI has initiated work on distance education, but there is an urgent need to study the problem in depth and to devise more methods and courses for on-the-job skills upgradation for engineers.

FUTURE COURSE OF ACTION

An efficient and responsive administrative structure should be instituted to monitor to the functioning of a set-up. It must be ensured that the benefits accruing from a project or industry are bottomed down to the poor for whose prosperity and welfare the project was conceived and implemented. This should be the corner-stone of our policy.

Finally, we come to what is easily regarded as the most-essential ingredient of any organization, private or public, the men.

We should attempt to transform the present appalling working system into a caring, efficient and responsive one. I strongly advise engineers and technologists, to develop a style of work that should be refreshingly informal, timesaving and result-oriented. We must reduce our paper work, lengthy memos, tortuous notes on files. I feel 'desk' is a dangerous place to know the project. Let us manage the job by 'walking' from job to job. We must come out from our glass houses and lavishly furnished air-conditioned offices and be a part of work-force in the field. I earnestly request the senior engineers and others who are occupying responsible positions in the management to infuse a feeling of oneness and comradeship among the engineers and the workers committed to the welfare and safety of the people and quality of work in an eco-friendly environment. Let us first reform ourselves before we go to reform the society.

I strongly feel that only an economically strong and socially cohesive India backed by a clean public life can earn the attention and respect it deserves in the comity of nations. Let us create an organization which lifts the self-esteem of the people and infuse in them a spirit of pride and being "Wanted" in the set-up.

Khudi ko kar buland ina
kai har taqdeer sai pehle;
khuda bande sai khud poochai
bata teri raza kya hai.

It means man make his self-reverence so sublime that for his each need God himself condescends and asks him as to what that need is.

Having been in the field of construction for more than 50 years, I can perhaps safely say that the Indian engineers and technicians are second to none. They only need the right kind of exposure and in-service training and education, and once they acquire these they can surely match their counterparts in any part of the world.

Let us ponder for a moment what Rabindra Nath Tagore, the recipient of Noble Prize, a great poet, philosopher and saint says:

"Where mind is without fear and
the head is held high;
where knowledge is free;
where the world has not been broken
up with fragments by narrow wall;
where words come out from the
depth of truth;
where tireless striving stretches
its arms towards perfection;
where the clear stream of reason has
not lost its way into the dreary
desert sand the dead habit;
where the mind is led forward by
thee into ever- widening thought
and action
into that heaven of freedom,
my Father, let my country awake'

We behold the destiny of lndia not a 'sun-set' but a 'dawn', which Rabindranath Tagore had visualized and had beautifully penned down the above lines.

Let us all work unitedly to realize the great dream of Tagore and make India a land where truth prevails and people are free from fear and narrow mindness, and they work ceaselessly to eradicate poverty, ignorance, superstitions and make the country a happier, healthier, better and more beautiful place to live in.

Finally, I would like to summarize my thoughts with the following recommendations to the Government with a believe that these will be considered seriously in order to make our country a strong and vibrant one.

o Formulate Policy on Water, Floods and Power.

o Formulate Policy on Rehabilitation of Displaced Persons in Major Hydro-project.

o Establish National Tunnelling Corporation (similar to NHPC and NTPC).

o Include 'Safety and Ecology Code' in the Contract Documents for the Execution of Works.

o Develop Strong and Dynamic Management Capable of Igniting the Self-reverance of People.

CONCLUSION

Since independence, we have acquired enough experience and expertise and now we should sit back and calmly decide upon the proper techniques to handle the problems in a big way. If we review the policy and manner in which we have been developing, we can see how the lack of a clear policy on a national level has resulted in disputes and controversies. We have not been able to augment the scarce resources, particularly skills, expertise and experience that we posses. To speed up the pace of our development, it is essential that we enunciate national policies on 'Water, Floods', Power, closely interrelated as these are. India of tomorrow has to meet unequalled challenges and in order to arm ourselves for rapid action, we should have a clear understanding in the water and power sectors before we launch an integrated effort to build the country into one surplus in food product and electric power generation.

Shri Jagman Singh—a Brief Profile

Born on November 10, 1924, Shri Jagrnan Singh graduated in Mechanical Engineering from the Punjab College of Engineering an Technology, Lahore (now in Pakistan) in 1945. He then joined the Punjab Irrigation Department in 1946 and worked under the stewardship of the world-famous American engineer, Mr M H Slocum, to harness the river Sutlej and build one of the greatest dams of the world, namely, the Bhakra Dam. He worked there for nearly 17 years (right from its very inception to its completion). On this gigantic project, he made immense contributions towards the maintenance and overhauling of equipment fleet (both earthmoving and concreting) and evolved new methods of preventive maintenance consistent with the job condition. He displayed ingenuity and vision in the use of indigenous products and' put them into effective use for the production of spare parts as also in the improvization of imported equipment.

Shri Jagman Singh's association with the Beas Project (Punjab) began in 1962 and lasted for nearly 11 years. This job too afforded him ample opportunities to display his skills and innovative ideas in the design and development of construction equipment. His innovations on this project related mainly to (i) cold bending technique (for girders for tunnel supports); (ii) design and manufacture of vibratory rollers (for the compaction of pervious material); (iii) manufacture of a 40t self-propelled fully revolving electric crane; and (iv)4.6 m' transit mixers. These innovations led to the saving of substantial amounts of precious foreign exchange for the country.

The above constructional feats earned due recognition from the Government of India, and for this Shri Jagman Singh was honoured thrice (in the years 1967, 1969 and 1971) with the Inventions Promotion Board's Awards.

Shri Jagman Singh was also awarded a Gold Medal by the Central Board of Irrigation and Power, Government of India for his paper on 'Vibratory Compaction of Pervious Material on the Beas project' which was adjudged as one of the best technical contributions. Besides several technical papers, Shri Jagman Singh has authored four outstanding books, namely, 'On and with the Earth,' 'Art of Earthmoving,' 'Heavy Construction-Planning - Equipment and Methods', and 'My Tryst with the Projects—Bhakra and Beas.'

Yet another ingenious work of Shri Singh was his design of high capacity axial flow and mixed flow pumps ranging from 10 cusecs to 150 cusecs for the various lift irrigation projects under construction in the State of Haryana which enabled the State to manufacture these pumps and reduce the dependence on foreign manufacturers for such units. The design and manufacturing processes developed by the Haryana State Minor Irrigation (Tubewells) Corporation, under his guidance greatly helped to further the technical know-how in the field as well as to build up the required expertise within the country itself.

In recognition of his eminent research, design and development endeavours and contributions in engineering, the Institution of Engineers (India) conferred on Shri Jagman Singh the prestigious National Design and Research Forum's Award in 1975. Shri Jagman Singh was also the Chief Project Engineer on Salma Rockfill Dam (Afghanistan) for two years (1977-79).

Shri Jagman Singh was Engineers in Chief, Department of Irrigation, Government of Haryana during 1977-1982. Later, he was associated with the Ranjit Sagar, Dam as Special Invitee to the Construction Planning Committee, and the Disputes Review Board of Nathpa-Jhakri Hydroelectric Project in Himachal Pradesh.

He has had a long association with the Institution both at the State and the National Level serving in many committees for the furtherance of the aims and objectives of IEI.

Shri H P Jamdar

President 2001-02

Presidential Address

Today, amidst esteemed dignitaries, top rung leaders of engineering fraternity, luminaries of the academic world, and a galaxy of engineering professionals from various parts of India and the neighbouring countries, we meet here this day for the inauguration of the 15th Indian Engineering Congress, organized by the Institution of Engineers (India), at the worthy hands of the Chief Minister of Andhra Pradesh. Hon'ble Shri Chandra Babu Naidu.

The Institution of Engineers (India) represents the engineering identity of our country. This great Institution, is the apex professional body of engineers, encompassing every discipline of engineering practised in India. Its origin dates back to 1920, when it was established, and was later accorded the Royal Charier in 1935.

We draw inspiration from the string of doyen of engineering, such as Bharat Ratna Sir Mokshagundam Visvesvaraya, Dr A N Khosla, Dr Triguna Sen, Dr K L Rao and many other illustrious engineering personalities, who were at the helm of affairs of this august Institution, which has played an eminent role in the development history of our country.

But, we also realize that no eminence or stature can be taken for granted. It can only be sustained by constant striving and dedication. Basking in the glory of the past, something that we seem to do very often in our country, is a pitfall that we have to consciously avoid.

Today, when I stand before you, to assume the Presidentship of the Institution, I am aware of the high responsibility, that goes with this highest office in the engineering profession.

I am grateful to the Council of the Institution and the engineering fraternity at large, for the honour they have done to me by unanimously electing me the President of the Institution.

I consider myself fortunate, to have been preceded by many worthy engineering stalwarts, who have left behind a legacy, that would inspire and guide me.

lt will be my earnest endeavour to build upon the useful work done so far, and strive for fulfillment of Institution's mandate, in real terms.

THE DEVELOPMENT SCENARIO

Friends, today we stand at a crucial stage of time, in our march of development. For more than four decades after Independence we pursued the path of protected economy that was chosen for us. Whereas we started off reasonably well, with our conscious accent on public sector, somewhere along the part, the pace of development faltered, and we found ourselves trailing behind our contemporary nations, who had acquired independence around the same time as us. The lack of competition afforded by protections of various kinds, made us complacent. The biggest casualty in the process was basic infrastructure in the country, which couldn't keep pace with the ever-increasing demand.

It was only in early '90s, when we decided to open up our economy, that we woke up to the stark realities of our deficiencies. In the postliberalization era, our trade and industry had to gear up to face stiff competition at global level.

However, the gross and all round deficiencies in infrastructure, like roads, power, ports, water supply, etc. made this task extremely difficult, and unequal. It is only then, that our planners recognized, even though belatedly, the neglect that our basic infrastructure had suffered all along.

India with its huge market potential, offers vast investment opportunities to international investors. But again poor infrastructure became the major stumbling block. Faced with these realities, removing the infrastructure deficiencies was finally given top priority, and corrective steps were initiated in right earnest. In the new scheme of things, the highest priority has been accorded to infrastructure development. Various steps, legislative as well as administrative, have been taken by the Central as well as State governments to attract investment in the infrastructure projects.

It is heartening to note that some excellent work has been done at the national and sub-national levels, in fields like roads, ports, power, etc. Imaginative structuring of projects on commercial formats like BOT, BOOT, etc. has led to some good success stories which could be replicated.

All this adds up to the fact, that our Country is poised for high growth, provided, the various challenges are met. with determination and meticulously planned strategies. And herein lies the challenge for the engineering fraternity of the Country.

The development over the past few years have amply demonstrated the prowess and high caliber of our technical manpower. It is heartening to note that the entire western world now looks up to India, for engineering professionals and technocrats who are rated as the best.

There is, therefore, no plausible reason, why we should not be able to achieve our own country's developmental targets. Only we need to consciously support the creative potential of our engineers and harness their abilities to the country's advantage.

In this mammoth task, the Institution is in a unique position to perform the crucial role of steering, guiding, coordinating and broadly overseeing the role of the entire engineering fraternity in all its disciplines across the country.

EMBRACING E-GOVERNANCE FOR EXCELLENCE

The theme of this Indian Engineering Congress, namely, 'The Role of Engineers in E-Governance' has been very aptly chosen. Firstly, because e-revolution is shaping the destiny of development world-wide. And secondly because the venue of this Congress is Hyderabad, which has earned the distinction of being the E-Capital of India. And it is only in the fitness of things that the personality, whose vision and dynamism have brought about this transformation from Hyderabad to Cyberabad, is himself in our midst today, to inaugurate this Engineering Congress.

In the new millennium we are touched by the dramatic changes in every aspect of our lives. The innovative thinking and powerful technologies have opened up new horizons in every area of human need.

Governments around the world, are rapidly aligning themselves with the requirements of a global economy and empowered citizenry.

The seamless 24/7 operation models of e-business can serve as examples for e-government initiatives also. Just like the global 24/7 e-business functionality can remove international borders for corporations, eliminating distance and time as inhibitors, by providing essential government services to citizens, it can also be usefully harnessed by government departments.

In this internet era e-governance is fast emerging as an enabler to governments in fulfilling their social, economic and moral responsibilities. The governments must plan to make full use of the new 'information rich' internet environment. With a streamlined and downsized setup, the governments could provide better services faster and cheaper.

Nevertheless, the human face aspect cannot be lost sight of, in matters of serving the people. The right blend of sophisticated technology and conventional wisdom, would, therefore, have to be evolved. And here again, the engineer has a special and challenging role to play.

GEARING UP TO MEET THE GLOBAL CHANGES

The forces of globalization are bringing about rapid changes. In order to cope with them, the engineering profession would be required to respond swiftly, to ensure that we don't miss many opportunities thrown up by the forces of change.

Developments like the WTO Agreement, are imposing restrictive procedures and norms which may put us at a severe disadvantage, if we do not act with alacrity.

In the atmosphere of stiff competition among nations, various regulative proposals keep coming up from the more developed countries. These may appear innocuous, but may carry a fine print having grave long term implications. And if we are not watchful, we may end up compromising our professional prospects. In times like these, professional bodies carry special responsibility, in safeguarding the interests of our people. On the positive side, Institutions like IE(I)can, and should, play the role of a catalyst, in imbibing true professionalism, and facilitate transfer of technologies that may suit our needs.

At this exciting stage in the developmental history of our country, let us resolve to rise above the parochial mind set, and work towards a better tomorrow. A tomorrow that would bring not only economic prosperity, but also a just and equitable social order. As technocrats let us blend engineering excellence with human concern. The responsibility of an engineer should not end with creating technological benefits, but should extend to ensuring that those benefits bring succour to poorest of the poor.

Let me finally add that merely praising the glorious history of our Institution is not enough. What is required is to ensure that its activities are focussed on the pressing problems of the society. Also required is to lend dignity and luster to the way we conduct its affairs .

And in doing so, I seek the support of all my Council colleagues and each one of you. There is nothing we can not achieve when we resolve to work together. Let us decide to speak in one voice, as said in the popular verse

"mile sur mera tumhara, to sur bane hamara"

I conclude by seeking the blessings of the Almighty and humbly urging him to bestow his blessings upon all of us, and on all the good things we strive to do.

JAIHIND

Shri H P Jamdar—a Brief Profile

Shri H P Jamdar, BE (Civil), FIE, is presently working as the Principal Secretary (Roads & Buildings) to the Government of Gujarat. Shri Jamdar graduated in civil engineering from Gujarat University in 1966, securing the first rank in the University at the BE (Civil) examination. Thereafter he was selected for Gujarat Service of Engineers (Class 1) through the Gujarat Public Service Commission, again securing the first rank at the competitive examination. After working in various capacities, Shri Jamdar was promoted as the Chief Engineer and the Joint Secretary in 1987 and was further promoted as Secretary to the Government of Gujarat in 1991. Shri Jamdar was the youngest technocrat to be elevated to the post of the Secretary to a State Government. In December 1999, Shri Jamdar was promoted as Principal Secretary to the Government of Gujarat and he is the first technocrat to be elevated to this rank in Gujarat. Incidentally, Shri Jamdar has had the Longest tenure as a technocrat Secretary amongst all the States so far. All through his distinguished career, Shri Jamdar has handled important assignments in various capacities, with distinction. Over and above his normal duties, he held the following additional posts at various times: Chairman, Gujarat State Construction Corporation Ltd; Chairman, Gujarat Maritime Board; Chairman, Gujarat Pipavav Ports Ltd; Chairman, Vadodara-Holol Toll Road Corporation Ltd; Chairman, Ahmedabad-Mehasana Toll Road Corporation Ltd; and Vice Chairman, Gujarat National Highways Ltd. Shri Jamdar has also been the President of the Indian Roads Congress (IRC), which is the apex body of highway engineers in India. As the President of the IRC. he has made important contributions in the field of road development. Shri Jamdar is a highway engineer of international repute. He has done pioneering work in introducing privatization in the road sector. He has travelled extensively throughout the world and has represented the country at premier international events Like the World Road Congress at Toronto; the International Roads Federation (IRF) at Montreal; the World Economic Congress at Washington; the Forbes' Conference at San Francisco, etc. Shri Jamdar happens to be on various important Technical Committees set up by the Government of India as well as by the World Bank for modernization of the road infrastructure in the country. On extra-curricular side, Shri Jamdar is an acclaimed singer and has recorded three audio albums of Hindi songs. Shri Jamdar also happens to be a keen golfer.

Prof (Dr) Samiran Choudhuri

President 2002-03

Presidential Address

I assume the office of the Presidentship of the Institution of Engineers (India) with all respect and humility. I convey my sincere thanks to all members of the Council of the Institution for unanimously electing me to this highest position of the largest professional body of engineers in the country While I am aware of my limitations, I assure them of my sincere services for upholding the image and objectives of our great Institution. I am really overawed on browsing through the names of my illustrious predecessors in this office and feel dwarfed by their personalities and specially of those with whom I was fortunate to work together in the past for the common cause of our Institution. I am further gratified by the presence of few of them over here and I am hopeful Sirs that with your blessings and with the unending cooperation from my colleagues in the Council, I shall be able to shoulder the responsibility that you all have vested in me. Let me take this opportunity, on behalf of all of you as well as on my personal behalf to congratulate and thank the retiring President Shri H P Jamdar for very ably stewarding the activities of the Institution during the last year inspite of his highly responsible Government duties.

I am sure, all of us over here, are aware of the role that a professional society plays in building up a Nation. Being the spokesman for a very large professional society, let me share some of my thoughts with you regarding the genesis of such societies and their importance in general.

History has taught us a lesson that throughout different era, many great thinkers, philosophers, reformers and scientists have suffered and were humiliated a lot at the hands of the rulers, because of their independent and rational thoughts. We remember the fate of Socretes during

Greek Civilization and those of Coppernicus and Galileo in medieval' Europe. It cuts across the nature of ruling class and of political ideologies. This statement is proved if we study the life histories of Oppenheimer in USA, Bertrand Russel in UK or Landau in the then USSR. But when a person speaks on behalf of a society, the opinions cannot be overruled so easily. To prove the collective contribution of a group of learned persons, let us take examples from our own country In ancient India, Gupta Dynasty signify the Golden Era and most illustrious king among the Guptas was King Vikramaditya. We know that he patronised nine learned people and framed a court comprising of them known as 'Navaratna Sabha', It is hard to believe that they were mere ministers, as their direct involvement in governance is not proved. While the king himself and his other paid staff are believed to be engaged in governance, advices of those elites headed by Kalidasa on policy matters led to the prosperity of the empire. This I call to be the genesis of a Professional Society, where great litterateur like Kalidasa, great scientist like Varahmihir and others were involved in continuous pursuit of knowledge and in applying this for the benefit of common people. The pattern was successfully repeated in medieval India during Emperor Akbar's regime. He also framed a court of nine elites under the leadership of Birbal helped India to flourish in all respects by their collective wisdom. In either case king's patronage was forthcoming for dissemination of knowledge generated through the then appropriate media. Let us for the time being lay this debate to rest for proper historians' comments and look to professional societies of modern era.

With the onset of renaissance and reformation, different countries in Europe started flourishing in domains of art, literature, science, and technology. It was gradually felt that collective wisdom of experts in the same discipline and constructive criticism of novel ideas helped in better innovation than a single genius could produce. It was with this view that bodies of individuals of experts of the same discipline were formed in many countries with a motive of interchange of ideas. Initially societies were mainly philanthropic in nature, whose objectives were benevolent and were created only for serving the mankind. Gradually other forms of societies also emerged what today we term as Professional Societies. Professional by literal meaning stands for a person who earns his living by selling his skill in any form. So basically he works for himself whereas through his work others get indirect benefit. Thus, the implication of a professional society is to first help its members to excel in their profession without causing any harm to human race or eco-system, and secondly at the same time help the country to prosper.

With the invention of printing press, works of experts started being documented in the forms of journals and magazines of each of these societies and were circulated in different libraries. This on one side resulted in increasing the level of knowledge among common people as well as commercial organisations and industries could ventilate their needs to the experts. A striking feature common to most of these societies was that they operated with least intervention of the ruling governments, though in many cases financial patronage were available from the state.

Having discussed about the history of development of professional societies in general, let us have a quick look to our own. The Institution of Engineers (India) established in 1920 and incorporated by the Royal Charter of 1935, has completed 81 years of its glorious existence. For convenience of projecting its future plans we can review its objectives and purposes as outlined in the Charter granted. For ready reference let me quote some excerpts therefrom.

(a) To promote and advance the science, practice and business of engineering in all its branches....

(b) To establish, subsidise, promote, form and maintain local Associations of members belonging to the Institution and others engaged or interested in engineering so as to assure to each individual member as far as may be possible equal opportunity to enjoy the rights and privileges of the Institution.

(c) To diffuse among its members information on all matters affecting engineering and to encourage, assist and extend knowledge and information connected therewith by establishment and promotion of lectures, discussions or correspondence; by the holding of conferences; by the publication of papers, periodicals or journals, books, circulars and maps or other literary undertaking; by encouraging research work; or by the formation of a library or libraries ....

(d) To promote the study of engineering with a view to disseminate the information obtained for facilitating the scientific and economic development of engineering in India.

(e) To establish, acquire, carry on, control or advise with regard to colleges, schools or other educational establishments where students and apprentices may obtain a sound education and training in engineering on such terms as may be settled by the Institution.

(f) To encourage, regulate and elevate the technical and general knowledge of persons engaged in or about to engage in engineering or in any employment with a view thereto provide for the holding of classes and to test by examination or otherwise the competence of such persons ...

(g) To give the Government of India, the local governments and municipalities and other public bodies and others, facilities for conferring with and ascertaining the views of engineers as regards matters directly or indirectly affecting engineering and to confer with the said governments, municipalities and other public bodies and others in regard to all matters affecting engineering.

(h) To encourage inventions and investigate and make known their nature and merits.

(i) To arrange and promote the adoption of equitable forms of contracts and other documents used in engineering and to encourage the settlement of disputes by arbitration and to act as or nominate arbitrators and umpires on such terms and in such cases as may seem expedient.

(j) To promote efficiency and just and honourable dealing and to suppress malpractice in engineering.

I have no intention of burdening my speech with facts and figures but I am sure that our annual report will speak for itself the way in which we are trying to fulfill the objective and purposes as outlined above. Still I believe that there is a room for improvement in every facet of our endeavour. Let me just share with you some ideas by which different sectors of our society may derive benefit from our activities.

Benefits to Government

Being a protagenist in the non-formal technical education system, we are the providers of by far the largest. number of technically qualified manpower in the country. Considering our very large population base and inadequate facilities of formal education, our endeavour is definitely helping in saving huge government expenditure. During last year the figure of about 55 thousand examinees for our AMIE examinations bear ample evidence to my above statement. It is not out of place to mention that different centres of IE(I) throughout India have actually arranged class room teachings of courses in accordance with the syllabi of our AMIE examinations. The syllabi are updated at regular intervals and we have just finished one such modification. The examination itself being all India in nature maintains uniformity of standard. The Central Government already recognises the credibility of this examination for the purpose of appointment in public sectors. Perhaps passing another competitive examination can be utilised as a pre-qualification for all government jobs as engineers, just as UPSC examinations are held for selection of bureaucrats. Divesting this responsibility to IE(I) would further save expenditure of the government and many other PSUS' in holding separate selection tests.

Recommendations of different technical seminars allow the government to get free technical advices from top grade technocrats of the country. This is of great help to policy framers and the Planning Commission. Besides this, the seminars on interdisciplinary topics arranged by us and interacted by industries thereon, help in ascertaining new specialised discipline over these topics. AICTE can think in the lines of introducing these courses in formal educational institutes. IE(I) here acts as a pathfinder of new professional courses in engineering.

Benefits to Academic Institutions

IE(I) regularly brings out journals in 15 different disciplines as also other technical publications like Seminar Proceedings, Newsletters etc. These publications are well edited by experts in their domains and are rich storage of frontline research works and technical developments in India. These volumes are valuable in two ways. Firstly young research students and junior executives in industry on reading these become aware of the recent trends of work in every discipline and can engage themselves in more meaningful research. Secondly, reputed technical institutes are continuously in search for good faculty members having a research bent of mind. The yardstick for judging the research acumen of a candidate is invariably his publications in reputed journals. IE(I) journals extend valuable service to faculty members in this respect. Further seminars and symposia arranged in different parts of the country allow the congregation of people from both academia and industries. This provides the participants opportunities for exchange of ideas and expertise. The Institution, though in a meagre way, has established certain prizes and endowments to encourage the engineers in creative works. Direct research grants to projects running in the academic institutes are also now available from IE(I).

Benefits to Industries

It is welknown that good health of an industry depends, interalia, on stress on R&D, proper marketing of its products or services, and skilled manpower. Possibly on all these counts, a well organised and well spread professional body like IE(I) is of much help. National Design and Research Forum (NDRF) of IE(I) located at Bangalore is active in new industrial product development. Retraining of executives is regularly done in our Engineering Staff College located at Hyderabad. Seminars and workshops organised at different centres of IE(I) provide an excellent platform for industries to propagate their skill and expertise through presentations. Their products can be exhibited during these conferences to technocrats, quite often who are the policy makers in their respective organisations.

Benefits to Individual Members

Any professional needs to keep himself updated throughout his career. An engineer is no exception to this. One can achieve this through reading books, journals etc, following programmes broadcast in electronic media, attending live demonstration of products and processes etc; but perhaps the best and quickest way to learning is to keep association with experts in the same discipline. On being a member of IE(I), perhaps one can achieve all these in a single go. We have good technical libraries in the headquarters and in many of our centres. Our own publications comprising of books, journals, seminar proceedings are available to our members at nominal costs. Our recently introduced Post Graduate Diploma Examination aims at the career advancement of qualified engineers in industry, who due to some reason or other are not in a position to join a regular full time Post Graduate course offered by colleges/universities. Presently we have aired our dedicated web-site where technical informations are regularly being updated. Many centres of us arrange technical visits to places of engineering importance. In fact, a member is entitled to attend and take part in any technical activity organised under the banner of IE(I), anywhere in the country. Further, all engineers of our country, irrespective of whether they are members of IE(I) or not, are invited to participate in the Annual Indian Engineering Congress, the apex event of IE(I).

Benefits to the Profession

As a body of engineers, we are ever conscious about the duties of engineers towards the society as well as the rights and privileges they deserve in the country. We make our members committed to certain ethics, which bind them with honesty, integrity and dedication to service. Side by side, we try to establish their status in administration, policy making and job responsibility. Our inputs to the oncoming Engineers' Bill in the Parliament and to Engineering Mobility Forum in the international arena are evidences to these. We believe that our creation of a special class of members called Professional Engineers will play a vital role on both the above aspects in coming years. However, our efforts must be untiring and sustained.

Benefits to the Society

Though our existence is primarily for the engineers, we in IE(I) strive to serve the common man Eradication of poverty, spreading of education, making the rural people self reliant through vocational trainings are some of our missions. Our Rural Development Forum, Water Management Forum and Sustainable Development Forum relentlessly work round the year to fulfil these missions.

Let our conclude, with a clarion call to all engineers of our country to join IE(I) and to strengthen our efforts in making our country more prosperous.

Prof (Dr) Samiran Choudhuri—a Brief Profile

Dr Samiran Choudhuri born in 1944 in Calcutta, obtained Bachelor's Degree in Electrical Engineering from Jadavpur University in 1965. After graduation, he was a trainee, CESC Ltd for an year. He was selected as a Technical Teacher Trainee under MHRD, Government of India and received Master Degree in Electrical Engineering in 1968. He then joined Banaras Hindu University as Lecturer and then IIT Kharagpur as Lecturer in 1970. Later he joined Jadavpur University as Lecturer then becoming Reader in 1975 and Professor in 1984. He is still continuing as Professor in Electrical Engineering at Jadavpur University. Dr Choudhuri received Ph D (Engineering) degree in 1974. His field of specialisation is Electrical Power Systems. He has so far published more than a hundred research papers in peered journals like Transactions of IEEE, Proceedings of IEE and Journal of IE(I). He is the author of three text books in electrical engineering and has guided several doctoral works. As a Commonwealth Post Doctoral Fellow, he visited UK in 1977 and 1981, respectively. As a Visiting Professor he delivered lectures at Universities of Manchester, Imperial College, London, University of New Jersey, USA.

Apart from his teaching and research commitments as a Professor in Jadavpur University, he was the Joint Coordinator of Part-time Engineering Degree Courses during 1983 to 1993. He was the Head of the Electrical Engineering Department during 1997 to 1999. From 1999, he is the Director of Confederation of Indian Industry Technology Transfer Centre at Jadavpur University. This Centre is the first of its kind in eastern India. He was a Member of the Faculty Council of Undergraduate and Post-graduate Studies of Jadavpur University between 1981-1988 and again between 1990-2001.

Dr Choudhuri was a Member of AICTE, Eastern Regional Committee during 1995-1998 and is a Member of West Bengal Council of Technical Education since 1998 and Member of Technology Committee of Eastern Region of CII since 1999.

Dr Choudhuri has served as Member in many selection committees framed by UPSC, WBPSC, Central Universities, State Universities etc. He is a Governing Body Member of several private engineering colleges.

Dr Choudhuri has a long association with professional societies. He was Joint Secretary (1978-1981), Secretary (1981-1984) and Vice President (1984-1996) of Institute of Instrumentation Scientists and Technologists (India). He joined the West Bengal State Centre Committee of IE(I) in 1982 and became Honorary Secretary of the Centre in 1984. He was elected to the Council of the IE(I) for the first time in 1988 and then again in 1992, 1996 and 2000, respectively. He was the Chairman of the Electrical Engineering Division during 1994-1996 and the Chairman of the West Bengal State Centre of IE(I) during 1996-1998. He was the Joint Secretary of the First Indian Engineering Congress in 1987 and Organising Secretary of the Platinum Jubilee Celebration Committee and the Ninth Indian Engineering Congress in 1994. In 2000 he was the Joint Organising Secretary of the World Congress on Sustainable Development organised by the IE(I). During the course of the last 13 years he has served in many important Committees of the IE(I) Council, such as Finance, Examination, Journal and Monograph, Information Science, Head Quarters Management and Syllabus. He visited Bangladesh in 2000 as a Member of IE(I) delegation. Presently, he is the Consulting Editor of the Electrical Engineering Division of IE(I) Journal and Editor of the trilingual Newsletter of Committee on Engineering & Environment of World Federation of Engineering Organisations (WFEO), which is brought out in English, French, Spanish.

Shri G L Rao
President 2003-04

Presidential Address

NEW CHALLENGES

We assembled here today amidst distinguished dignitaries, galaxy of veteran engineers and academia from all parts of the Nation and from some of our neighbouring Countries, for the inauguration of the 17th Indian Engineering Congress organized by the Institution of Engineers (India).

As many of you are aware, The Institution of Engineers (India) encompasses 15 disciplines of Engineering, represented by around half a million Engineers, across the length and breadth of the country. It being a premier professional body established in 1920 by Thomas Holland and bestowed with a rare recognition of grant of Royal Charter in 1935, has been endeavouring to render its services as a 'think tank' to the Governments and people on various technical issues. We all owe greatly to all eminent engineering wizards who laid the path, showed the direction and set the goals to our great Institution while they were at the helm of affairs of the Institution.

I stand before you to assume the Presidentship of this august Institution and I am aware, how responsible the position is, I with great humility thank the Council colleagues and Past Presidents for the confidence reposed in me and electing me as the President. of this great Institution. At this moment of great joy, I pray my Master, Pujya Shri Parthasarathi Rajagopalachariji. Spiritual Head of Shri Ram Chandra Mission to bless me with the strength and courage, to discharge my duties, striving relentlessly. without any bias and in the best interests of promoting and fulfilling the aims and objectives of this Institution, set by my predecessors.

I earnestly feel that we should re-dedicate ourselves for sustaining the glory of the Institution, which doyens of Engineering left behind and also to enhance our services through the advanced technology now available with us for development of mankind and advancement of nation in all spheres equipping to face boldly the challenges ahead in the present 21 st Century.

All of us are looking forward to. with great hopes expectations and also with some trepidation, how will this Century be different from the one that has passed off. We are unable to imagine, even after completing couple of years, what kind of innovative technical developments will take place in this Century in the World in general and our Country, in particular.

The 20th Century was marked by a plethora of inventions and discoveries. The Technologists. Scientists and Academicians had moved giant wheels of Industry and given a new perspective, purpose and promise to plenipotentiary technology. In the first half of the Century all Industries, Organisations, Business Houses etc depended on physical and material infrastructure for developmental activities. and in the later half on management and infrastructure

Since, the advent of industrial revolution. different periods have been marked by advances in different clusters of inventions.

The First wave of inventions, which lasted for 60 years beginning 1785 was marked by progress in water, power, textiles and iron.

The Second wave lasted for 55 years between 1845 and 1900 and this was propelled by inventions in rail and steel.

The Third wave beginning 1900 and going up to the end of the first half of the last Century was marked by inventions in electricity, chemicals and internal combustion engines.

The Fourth wave was powered by oil, electronics, aviation and mass production.

We are in the midst of the Fifth wave, dominated by semi-conductors, fibre optics, genetics and software. Even this wave may end soon, giving rise to a new wave of inventions.

It is indeed very difficult to forecast what the future holds out in terms of scientific discoveries and technological developments. It is interesting to ask ourselves whether any Scientist would have forecast the Computer Revolution, at the beginning of 20th Century However, some have been brave enough to look into the future.

One study by a leading American University forecast the picture as follows:

The four-information technology fields, namely, (I) Computer Hardware, (ii) Computer Software, (iii) Communications, and (iv) Information Services will lead to the new wave of innovation.

First: Technological changes are going to be even faster, unexaggeratingly we can say that this Century will be characterised by fundamental and phenomenal changes in technology.

Second: The present Century will see greater integration of the economics. The process of Globalisation will gather future momentum. The new technologies do not recognise geographical frontiers. Speed in communications will accelerate flow of goods and services along with finance; and to what extent this will lead to greater human mobility, one does not know, and

Third: The wave of rising expectations will surge even further. All countries will become aware of the changes happening all over the world and the developing economies will naturally demand that their aspirations are met.

History has shown that modern economic growth has been inspired by a rapid and persistent up-gradation of technology and scientific knowledge. It is estimated that from one-third to one-half of the growth, experienced by the industrially advanced countries, has come from technological progress. Thus, technology has emerged as the principal driving force for long-term economic growth. Economic growth results both from slow and steady improvements in Technology as well as from the 'break through' inventions. Break through inventions are, however, unpredictable and such inventions change almost the direction of the entire industrial structure. Scientific discoveries and the consequential technological changes have completely revolutionised the life style and living standards of people.

The technology and engineering will have great advancement in next Century. Gone are the days of inaction, indecision and vacillation. Today, we are in IT age, in IT Society, people do banking, insurance, buying and selling, designing, planning, writing, entertaining, learning, teaching, balloting, messaging and governance etc by extensively using Information and Communication Technology (ICT). To address various engineering problems, the IT, as a tool, will play a remarkable role. With information and data available, the engineers straight away go to make solid model, carryout various analysis and finalise the details of a component or a project. PCs and Workstations will help attempting different configurations to firm up the concept and design.

Most work can be done without going to offices, but from wherever one wishes to, through communication terminals like PCs.

The trend in India unmistakably is towards evolution into an Information Society, which will be the growth engine. If we look at the GDP of 1951, the contribution of Agriculture was 62%, Industry 22% and only about 20% from services. But by March 1999, the contribution of Agriculture has gone down to below 25% and that of the Services has gone up to 52%, while the Industrial sector has slightly increased to 25%. It will not be long before the wealth contributed by the service sector will increase to 60%.

The development of a State or a Country is mainly decided on the basis of its GDP however, ignoring or forgetting the other important elements Development has two dimensions-human and economic. Human development relates to well being of each and every person, which is indicated, inter alia by

- Food
- Health
- Shelter and
- Access to safe and protected drinking water.

Our production of fruits/vegetables is second top in the World, but it is not sufficient for the minimum requirement of the population. The present population of 10 billion, in India is estimated to reach a figure between 1.50 billion to 1.80 billion by 2050. The UN agencies have put the figure at 1.64 billions The food requirement during 2000 AD was about 200 Million Tonnes, which is expected to increase to about 400 Million Tonnes by 2050 AD. Food, water, sanitation, housing and host of other things determine the health status of a Country. According to WHO, 'Health is a State of complete physical, mental and social well-being and not merely the absence of disease or infirmity'.

Our country, I foresee. will have to face formidable challenge of harnessing Water Resources in the early part of the present century to have adequate food. health and drinking water apart from plethora of other challenges.

It is generally accepted that the countries with annual per capita water availability less than 1700 cubic meters are said to be water stressed and less than 1000 cubic meters as water scarce. India would, therefore, need 2788 billion cubic meters of water annually by 2050 to be above water stress zone and at least 1650 billion cubic meters, to avoid being water scarce country.

India possesses 4% of the total average annual run-off in the rivers of the World. The per capita water availability of run-off, in India, is only 2200 cubic meters per year compared to the availability of more than 17500 cubic meters in USSR. 6500 cubic meters in Japan and 6200 cubic meters in USA. With the rapid growth of population even the figure of 2200 cubic meters will dwindle further.

The annual precipitation of our country, which is the source of water, is estimated at about 4000 cu.km, including snow fall. Out of this, the seasonal rainfall is of the order of 3000 cu.km. As per the assessment made by the Central Water Commission (CWC), the average annual runoff of various river basins in India is about 1880 cu.km treating both surface and groundwater as one system. But over 90% of the annual run-off in peninsular rivers and over 80% in Himalayan rivers occur during the four monsoon months of June to September. Further, the availability of water also varies from place to place and is not spread uniformly over the country, creating pockets of scarcity is very much dependent on the extent of storage that is only about 1140 cu.km out of 1880 cu.km.

Besides the storage capacity. the inter-state disputes in sharing of river waters would be another aspect the country is seriously threatened with. Let us be cautious about 'Water Wars'.

Our country is endowed with bountiful natural resources. In fixing priorities, the planners are yet to make good effort for all-round economic development with newer technologies. Perhaps our country is an example to quote, which callously avoids utilising the pollution free Hydel power. It is because; out of available potential so far we could tap about 20% of Hydel power. We are fascinated to burn the coal and add Carbon dioxide to the air. We are eager to depend on Thermal power rather than pollution free Hydel power and Non-conventional energy. This century, certainly, out of shear necessity, will go for developed technology for adding pollution free power to our present installed capacity. to meet the crying demand of industry as well as agriculture. The industrial growth largely depends on ensured basic infrastructure of power. To the extent the private sector fulfils its initial promises of providing the investment, the State's responsibility will be eased.

Old concepts are crumbling and the new ones are emerging 'Many of the things that gave support and meaning to our lives are disappearing. Institutions we relied on, particularly the work organisations are no longer so sure and so certain' a Britain's foremost business Philosopher. Charles Handy said. Societal and ecological crises and massive institutional break-downs are visible on a scale unheard of. It seems that the rate of change will last forever and continue accelerate to devastate whatever is existing. My Master Shri Chariji said, 'Change is the only thing that is Permanent'.

Associated with rapid changes in technology, the new century has to cope up with the acceleration of globalisation. The term 'globalisation' evokes several concerns in the minds of many of us. People are afraid that it could lead to political and economic hegemony, if not in physical but in ideological terms. But globalisation, in one sense, is not a new phenomenon. Its roots extend farther and deeper than the visible part of the planet. It is as old as history, starting with the great migrations of people across the great landmasses. Only recent developments in computer and communication technologies have accelerated the process of integration. with geographic distance becoming less of a factor. Is this end of geography a boon or a bane? Borders have become porous and the sky is open. With modern technologies. which do not recognise geography. it is not possible to hold back ideas either in the political and economic or in the cultural spheres.

While one segment of the society may be in a position to adopt new technologies, a very large segment may find it difficult to fill the gap, even though some leap frogging in technology is possible. We have to find effective answers to both challenges. For the large mass of people engaged in various productive activities, we will have to find out what is the relevant or appropriate technology in the changed situation. In this knowledge based society, the changes of this century can be met only by knowledge accumulation. One with more knowledge will be the winner in the market.

Each country must prepare itself to meet the new challenges so that it is not bypassed by this huge wave of technological and institutional changes.

Engineers and technologists have to decide very fast—much faster than might have imagined even till the other day. There will be only two kinds of engineers—the quick and the dead.

Amid all the chaos, engineers must reassess and review the present and define a new order and lead the society and industry into a new Century with a new vision. Vision according to Joel Barker, I quote.

'Vision without Action is merely a dream;
Action without Vision just passes the time;
Vision with Action can change the World'.

Thank You

Shri G L Rao—a Brief Profile

Was born on October 13, 1935 in Athreyapuram village of East Godavari, a coastal district of Andhra Pradesh.

Graduated in Civil Engineering (1957) from B M S College of Engineering, Bangalore. Did post graduate course, at Budapest (Hungary), in Hydrological Methods for Developing Water Resource Management.

Joined A P State Government services (September 1957) as Engineer in the Irrigation Department. On deputation, served BHEL, Hyderabad at its initial stage of construction and also served the A P State Irrigation Development Corporation in the capacity of General Manager.

Worked in various capacities in many Major and Medium Irrigation Projects of A P from formulation to commissioning, which include Nagarjunasagar Multipurpose Project, Srisailam Hydel Project. and Vamsadhara Project and on attaining superannuation, retired (October 1993) as Administrator-cum-Chief Engineer.

Visited Europe and Egypt to study irrigation practices to implement them in Andhra Pradesh.

Attended 19th Annual South East Asia Network Convention (SEANET 91—HAM Convention) in Thailand, as the Vice Chairman of National Institute of Amateur Radio, a non-government organization of unique reputation in providing communication facilities during the hour of need to all in and outside the country to combat natural disasters like Cyclones, Earthquakes etc.

Recognising his technical expertise, a rare honour was bestowed on him by the Hon'ble High Court of Andhra Pradesh by appointing him as Technical Expert to assist the Judicature in pronouncing the judgment on technical litigations. His services are being utilized by Government of A P as Technical Expert for some of the contracts of Major Irrigation Projects funded by World Bank and other external agencies.

Founder Member of a Local Centre, IE(I) (1957), established in memory of Dr K L Rao and was Honourary Secretary of Vijayawada Local Centre of IE(I) during 1982-1984.

Was Chairman of A P State Centre (1994-1996) and during his tenure, the Diamond Jubilee Year Celebrations were held all through the year and received accolades of the elite of the state.

Established a record by getting elected to the Council of the IE(I) continuously for three sessions, ie. 1993-1997, 1997-2001 and 2001-2005 from the A P State Centre proving that he enjoyed the highest plaudits from all the Corporate Members of the State.

Vice President of IE(I) (2000-2001)

Served/serving on the following Committees of IE(I) for the past ten years as

Chairman

All India Technicians' Committee (AITC); Service Rules and Headquarters Management Committee (SHMC); Civil Engineering Division Board (CVDB); Land and Buildings Committee (LBC); Water Management Forum, SRC (WMF); and Rural Development Forum, SRC (RDF)

Member

Committee for Advancement of Technology & Engineering (CATE); Bye Laws Committee (BYC); Education, Examination and Accreditation Committee (EEAC); Journal & Monograph Committee (JMC); National Languages Promotional Committee (NLPC); Regional Coordination Committee (RCC); and Finance Committee (FC)

Board of Governors

Engineering Staff College of India (ESCI); Water Management Forum (WMF); and National Design and Research Forum (NDRF)

Director

Master Consultancy Services

Member

Planning Board, Sister Nivedita College of Professional Studies

Associated with a number of Professional Institutions such as

Life Fellow of Institution of Valuers (F 4122); Life Member of Indian Institute of Plant Engineers (LM 226); Life Member of Indian Water Works Association (LM 308); Life Member of Indian Geo-technical Society (LM 300); Life Member of Indian Association of Hydrologists (LM 166); and Life Member of Indian Council of Arbitration (LM 1587)

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Shri O P Goel

President 2003-04

Presidential Address

It is my proud privilege to be amongst the august gathering of distinguished dignitaries, galaxy of eminent engineers and luminaries of the academic world from all parts of the nation and even from outside, assembled here for the inauguration of the 18th Indian Engineering Congress, organized by The Institution of Engineers (India), at the worthy hands of His Excellency Shri Vishnu Kant Shastri, the Hon'ble Governor of Uttar Pradesh.

As most of you are aware, The Institution of Engineers (India) is the premier professional body, established in 1920, representing the engineering fraternity in its entirety, across the length and breadth of the country. The Royal Charter had been conferred on this body in 1935. The Institution of Engineers is the only body in India having a Royal Charter.

The Institution has had the honour of being steered by some of the legendary figures in the field of engineering, such as Dr A N Khosla, Dr K L Rao, Dr TrigunaSen, Gen Harkirat Singh, Shri Kanwar Sain and many other illustrious engineering personalities. Today the Institution has 15 disciplines of Engineering, over 450 000 members, 95 State/Local Centres and also 6 Overseas Chapters. The Institution has grown substantially in its strength and relevance over the years and with the changing environment through globalization, the Institution is now in the process of reinventing itself to respond more effectively to the emerging needs of this fast changing world.

The engineering profession is the lifeline of any society. Do we ever realize how much this profession touches our daily lives? I quote from the words of Thomas Sowell from the Stanford

University "It was not our enlightened crusaders who brought light to the masses, it was Thomas Edison. It was not our intellectuals who ended the insularity of isolated communities; it was Henry Ford and the Wright brothers. For the people in the street, Kodak did more to make them aware of pictures than Rembrandt and all the museums put together!" The impact of engineering is easily the most visible of all the professions. The houses, we live in, the roads, we traverse, the electricity, the vehicles, the household gadgets, the rockets, computers, phones, you name it and the same is the result of the engineering profession. Engineers play prominent roles in our society — today majority of our CEOs are engineers, majority of students getting into IIMs are engineers and so is the case even with IAS.

India has the biggest assets in the form of engineers. The biggest export is the knowledge of engineers and the work of engineers. The amount of foreign exchange being earned by the engineering professionals abroad has helped to build up good foreign reserves.

But does the engineering profession get its recognition and the position in the society, which it deserves? The answer, unfortunately, is a straight NO. Who is to blame for this sad state of affairs? This needs introspection. We however cannot absolve ourselves of the blame fully.

I stand before you, today, to assume the presidentship of this august institution, with all respect and humility, and with the strongest commitment to contribute my most towards putting the engineering fraternity in its right place and esteem in the society. Though this is a mammoth task for an individual, but collectively this august institution has done considerably and would do much more, towards this cause. I take this opportunity to reiterate my commitment for upholding the image and objectives of our great Institution and also the profession of engineering.

I convey my sincere thanks to the Council of the Institution for electing me to this apex position. I am confident that with the support and co-operation from my colleagues in the Council, I shall shoulder the responsibility that has devolved on me, I was and shall continue to remain a devoted soldier to the cause of the Institution.

I would like to offer my sincere gratitude to my worthy predecessors for their contribution and guidance this great Institution has received for attaining its present stature. I look forward to their continued support in the multifarious activities of the Institution contributing their valuable expertise and guiding us to take this prestigious Institution to greater heights.

It is my duty to convey my personal gratefulness to the outgoing President Shri G L Rao for his able stewardship.

Sustainable Development

One of the biggest challenges facing the country and the world today, where the engineers have to play a major role, is the issue of sustainable development. The current strategies followed to meet our developmental needs are not sustainable. It is estimated that 80 per cent of the world's resources are being consumed by 20 per cent of the world's population. The world's poorest 20 per cent earn 1.4 per cent of the world's income. For more than 30 per cent of the world's population, poor sanitation, malnutrition, and air pollution are still the major causes of illness and death. The urbanisation is unabated as rural poor are increasingly migrating to urban areas and living in inhabitable situations in slums. Urbanisation has been proceeding at a rapid pace the world over, especially in developing countries and is expected to accelerate in the future. Today, the world's urbanisation is nearing 50 per cent and soon more people will live in urban than in rural areas. It is estimated that 600 million people have been added to the world's urban areas during the last decade, which is about two-thirds of the expected total population increase in this period.

In India too, it took all of history upto the beginning of 20th century to reach 25 million mark of urban population. Now urban population is doubling every 20 years. The growth of urban population in India during the past decade indicates higher growth for metro cities. At this rate, over the next 40 years, India will overtake China and become the most populous country of the world. The census of the year 2001 has revealed that the Indian population has crossed the billion mark and has touched 1027 million. Accounting for a population of 285.35 million in urban areas of the country, the census indicates that the level of urbanisation has increased from about 16 per cent at the time of independence to 27.78 per cent in 2001. In 1991, there were 6 mega cities (4 million +) and 23 million + cities, which have increased to 35 in 2001.

The changing demographic patterns demand for a very fast rate of development to cater to increased demands. However, in the recent times, there has been a growing realisation for sustainable development evident in the global concern for preserving and protecting the environment, yielding rich dividends in terms of sustenance of life, besides conferring perennial economic benefits. The World Commission on Environment and Development has defined sustainable development as "development which meets the needs of the present without compromising the ability of future generation to meet their own needs." The principle of sustainability advocates returning to the nature more than what we take from it so that there is no depletion of resources.

Social sustainability calls for utilisation of natural resources to ensure equity arid social justice while reducing social disruptions. The issues of worker health and safety, impacts on local communities, enhancement of quality of life, equitable distribution of benefits to disadvantaged /vulnerable groups are addressed by this concept. Social sustainability can be achieved only through strong and systematic participation of the community and the civil society.

Economic sustainability relates to the maintenance of capital intact or "living on interest rather than the principal". It involves creation of new markets, cost reduction through enhanced efficiency as well as reduced energy and raw material intake and creation of additional added value.

It is necessary to preserve the delicate balance striking a consensus between environment and development to ensure long-term sustainability. Environmental sustainability seeks to ensure that the development takes place in conjunction with environment and the energy reserves are conserved for the future generations. It involves reduction in waste generation, control of emissions to environment, reduction of the impact on human health, use of renewable raw materials, etc.

Scientists have estimated that the humanity's demand for resources has soared during the past 40 years to a level where it would take the planet 1.2 years to regenerate what people remove each year. The impact by humans on the environment had inched higher since 1961 when public demand was 70 per cent of the planet's regenerative capacity.

The biggest challenge today is to see how best development can take place with the least amount of negative impact on the environment creating environment friendly, ecologically appropriate, energy saving and sustainable developmental options — sustainable not only for the present generation but also sustainable to the emerging generations down the line.

The role of engineers in innovating and developing technologies that aid sustainable development gains utmost importance. The engineers have to take a driver's seat to usher in the new paradigm of development process.

If I can list three major issues that confront us, they are water, energy and environment. These are the areas where technology, financial resources and management have to play a major role and these are the areas also where many initiatives would be needed for partnership between academia, industry and the people, also an area where the Institution can play an effective role.

Water plays a critical role in any country's welfare with indirect linkages to most aspects of its economic development. Integrated management of water resources is another front where concerted action by engineers and planners is demanded for ensuring sustenance of life on earth. The fall in ground water table is plaguing many parts of the country leading to severe drought conditions in parts of Rajasthan, Gujarat and Madhya Pradesh. The overexploitation of ground water resources to the levels of 60 per cent in Tamil Nadu and 53 per cent in Rajasthan are partly responsible for the rapid fall in water table. Moreover, even in areas of heavy precipitation, a major share of the storm water is lost to the sea by run-off on account of the large proportion of paved surfaces impeding ground percolation and the ineffective resource management practices. Rain water harvesting, aquifer recharging and waste water recycling biologically appropriate systems need to be practiced on a large scale. Integrated waste management is another focal area needing the attention of engineering fraternity, which is essential to ensure appropriate disposal and recycling of agricultural, municipal and industrial waste and preventing the indiscriminate abuse of precious land for dumping garbage. The recycling of waste for building materials, fuel and manure or energy recovery should be promoted. Sustainable waste management practices are required not only for municipal garbage but also for industrial refuse or bio-medical waste which are hazardous and toxic.

At this crucial juncture, the engineering community has only two options, either to continue the developmental process as prevailing today and aim for plenty for today with indiscriminate use of resources, both materials and energy, without caring whether the future generations will be left with adequate resources to sustain themselves. But, mind you, nature is not so benign on its own being misused beyond a degree. It has its own balancing mechanisms to see that we do not surpass the threshold by creating environmental disasters, like global warming and events of similar nature having profound impact on humanity. The other option, the more sensible one, is to live in harmony with nature and to respect the nature's limit by using the resources appropriately. It is absolutely certain that nature does provide enough resources for all of us to sustain collectively. The choice is to be made by us today to have a better future and I would like to take this opportunity to exhort the engineering community gathered here to work towards ensuring sustainability in all our actions. The engineering fraternity can offer a lot to the country and the Mother Nature in this regard.

The Institution of Engineers (India) has been playing a pro-active role in this respect by bringing about awareness through conferences, seminars and workshops. We rededicate ourselves to continue the same with renewed thrust.

The three fora of The Institution of Engineers (India), namely, Sustainable Development Forum, Water Management Forum and Rural Development Forum, have been acting in this regard and promoting the concept of environment protection and sustainable development.

Engineers in Development

As mentioned 'earlier, the engineers play a pivotal role in all-round development of the nation. That is precisely the topic of the Congress Seminar. Deliberations will be held extending over three days on all aspects of engineers' involvement in the development of the nation in various sectors.

Engineering Education

The engineering profession, especially the budding engineers, needs to be sensitized to the emerging requirements in the coming years, which are quite different from those of the last decades. For the same, the major requirement is to constantly upgrade the quality of engineering professionals as well as meeting the increasing demand for more engineers. The syllabus of engineering colleges must embrace an interdisciplinary, systemic approach and should be regularly updated to address emerging issues.

The need for increased quantity of engineers for meeting the developmental needs of the country does call for more institutions, but the indiscrimate mushrooming of engineering colleges with little or no infrastructure, lack of adequate faculty, etc is a cause for concern. Through this platform, I would like to assure that the Institution is fully seized of the problem, and I shall continue the work which my predecessors have initiated.

The Institution of Engineers (India) has been providing opportunities for upgradation of qualifications and skills to diploma engineers for a long time. The same has been helping the society and the government by availability of good number of engineers without much cost. The Institution of Engineers (India) has also started post-graduate examination for allowing opportunities to the working professionals. The Institution is poised to play the role of an open/ deemed university and efforts in this regard shall be made. The Institution of Engineers (India) has recently updated the syllabus for its Associate Membership Examination.

Continued Professional Development

The Institution stands for the need for continued professional development, with a view to empower our engineers to deal with the emerging challenges with the tools which the new research and development has to offer. The training for the engineering fraternity for various spheres of their operations needs to be provided extensively for which the Institution professes the need for more interaction between the industry and the training institutions and the academia as a whole. The training bodies themselves must have a close networking to be able to provide training more effectively.

The Engineering Staff College of India (ESCI), Hyderabad, which is one of the peripheral bodies of the Institution, has been playing a leading role in the continued professional development. The efforts need to be augmented many folds by involving various centres of the Institution particularly in the metro cities so that the working engineers in the industry and the profession have opportunities to keep themselves abreast of the state-of-the-art.

Research and Development

The research and development in the field of engineering is given little emphasis in the country, primarily due to lack of financial resources as well as the facilities for the same. The Institution would like the government to provide enabling inputs to promote the R&D activities in the country. The engineering research presently is limited to a large extent in the laboratories of CSIR and the defense laboratories. We need to expand the same with the involvement of the private sector enterprises particularly in the areas of application oriented R&D.

We are now at the dawn of the new era where the new generation faces daunting challenges in the practice of engineering as a profession. The engineering community needs to work in unison to ward off the innumerable challenges posed by the contemporary developments, advances in technology or growing aspirations of the society. Being the sculptors of every civilisation, the engineering community holds the key to moulding the basic building blocks of socio-economic environment and weaving the intrinsic cultural fabric of every human settlement and activity. It is essential to take the cue from our ambient environment banking on lessons from experienced practitioners, to reorient ourselves in evolving right sized and tailor-made engineering solutions for future.

Engineers' Bill

The engineering profession is generally unregulated, especially in respect of the civil engineering profession. The proposed Engineers' Bill, where the Institution has provided major contributions, shall to a large extent, pave the way for a more regulated environment for the engineering fraternity.

By a proper rapport with the professional bodies and liaison and follow up with the

Government of India, renewed efforts need to be made to get the Engineers' Bill into Act of Parliament at the earliest possible.

Engineers' Mobility

The globalization and the liberalization of the economy has led to a total reorientation of the role of engineers in view of the advancements in technologies, competition from new players and most importantly the WTO regime that has far reaching consequences on the engineering fraternity. The Institution is already sensitized to deal with the changes and the active role it has played in getting provisional membership of the EMF, is very significant and we shall continue to support the efforts to empower our engineers to be able to deal with the rapidly changing environment.

Membership

First of all, it is high time, we all, the engineers in various disciplines, come together on a platform to unite and promote ourselves in the society. Self-promotion depends on one thing, telling our own story, and we don't do that too well." But we all have to do it to be recognised in the society. Be it the Bhakra Nangal Dam, the Konkan Railway, the software dominance or the fact that our engineers are today the CEOs of major companies in the USA, let us all tell that loud and clear, so that it is audible to the society which needs to recognise us. In this regard, I would urge upon the members of the Institution to be more vocal and concerned on the issues facing the fraternity. I would also like the membership of this august institution, which is already nearly 450 000 to grow further to give it more force to be able to push its agenda more aggressively. I would like each member to work assiduously towards the same and enroll as many members as they can. The membership drive would be a cornerstone of initiatives I propose to take for the next year.

In the past, in most of the government departments, all engineers were encouraged to become members of the Institution by subsidizing the membership fee by the government so as to enable the engineers to gain up-to-date technology. Though Fifth Central Pay Commission has liberalized this provision, still many central departments have to take initiative in this regard. Engineers employed in the industry also have to be brought more and more into our membership as also the self-employed professionals. In a population of 25 lac engineers, a corporate membership of 80000 or so is a very small number. It will be necessary that these numbers swell to a decent proportion.

National Policy Formulation and Decision-making

One of the responsibilities enshrined in the Charter of the Institution is to render advice to Central and State Governments and local bodies. The Institution has been rendering this service quite effectively but of late this has not remained very interactive. The Institution arranges seminars at local, regional and national level where issues are discussed and views of top professionals become available. They are then pooled and The Institution of Engineers (India) can give the advantage of pooled wisdom to the public bodies.

The engineering community must become engaged in the policy formulation and decision-making process through its technical and professional societies and the Institution should mark its presence in the policy formulations and contribute significantly in the process. The revision of the National Building Code, which is presently underway, is one such example where the Institution has played a very significant role and I would like the Institution to contribute extensively its expertise in formulation of new policies. The enactment of the Engineers' Bill, for which the Institution has been playing a major role, would be a great achievement. The Institution has also played a major role in the passage of the Electricity Bill. The Institution would continue to play its role in formulation of major policies by the government for the development of the nation and benefit to the society.

Image of Engineers

The image of engineers has to be enhanced in the public mind and the Institution is committed to take all necessary steps in that direction. After all, it is the largest body of engineers in the country and possibly in the world, and we should use our collective strength to stress for an appropriate recognition for the engineers. "Engineers are the people who make things work." But it is unfortunate that engineering still remains the invisible profession in the world. Let us all work together to do our best to bring the engineers their rightful due.

The Institution has been giving recognition to eminent engineers at its various annual congresses and annual conventions of various disciplines. The society needs to take note of that and provide due recognition at national, societal and government level to engineers by conferring on them, like other artists and professionals, Padma Bhushan Awards and even their inclusion in public bodies like Rajya Sabha. The engineers also have to rise to give visibility to their achievements and shed their shyness which has kept them in the background for a long time. It will be an endeavour to bring this into lime light through press, interviews, T V projections and other media. The achievements of apex personalities and details and difficulties of achieving the projects shall be projected.

National Building Code

The National Building Code which gives guidelines to the various government, local bodies, builders and professionals on various aspects of planning, designing, structural stability, durability, functionality, economy, etc is a document evolved by BIS. The same is being revised to bring in the latest practices. The Institution of Engineers (India) has played a vital role by organizing seminars all over the country and sharing high level opinions and assisting the BIS in proper formulation of the national building code simultaneously seeking to providing due deserved position to the engineers in the whole gamut of buildings, thus providing surety regarding safety, economy, usefulness and durability to the users.

Disaster Management

BIS are proposing to bring out a National Code on Disaster Management. The Institution of Engineers (India)'s support and interaction has been sought.

The Institution of Engineers (India) is holding a World Congress on Natural Disaster Mitigation from February 19-21, 2004 at Delhi. The outputs of the congress will be very useful for the code. The Institution of Engineers (India) shall participate in this national task.

The Government of India with the co-operation of UNDP wish to bring about awareness and training about disaster related matters amongst engineers. The Institution of Engineers (India) shall be holding seminars at various centres to assist in the national efforts.

Interlinking of Rivers

The mega project of inter-linking of rivers is one opportunity where Institution has offered its services to the government. This project is a challenge to prove our engineering mettle and demonstrate to the public at large the major potential it has towards improving lives of our countrymen.

Safety and Quality

Safety and Quality are very important parameters in all engineering operations. Need for bringing awareness, upgradation of knowledge and skills, setting of systems for monitoring and achieving results was paramount.

The Institution has set up a Forum on Quality and Safety. This Forum shall fulfill the tasks in this regard and will bring in value addition in the profession.

Conclusion

All these ideas are possible to be implemented with the cooperation and support of all engineering professionals, particularly the corporate members of the Institution and more importantly the council members of the Institution of Engineers (India).

Blessings of the leaders at the centre and the States, bureaucracy controlling the different ministries and also the engineering brethren holding senior positions in the government, public sector and private sector are essentially needed. I appeal to all of them, to help the profession to regain its glory and assist the Institution in becoming an instrument of mass movement for upgrading of the professionals giving dividends to the nation through increasing productivity and better projects without time and cost over-run, safety, durability and economy, alleviating poverty of the masses and ushering an era of plenty and prosperity.

Thank you.

Shri O P Goel—a Brief Profile

Shri O P Goel, FIE, is a top level expert on management of construction projects with credit of completion of several Built Environment and Infrastructure Development projects in India and abroad. He has more than 45 years of experience and has worked on a number of policy level committees of World Bank and Government of India. His regular assignment before superannuation was that of Director General, Central PWD, a position equivalent to Secretary to Government of India. Important projects to his credit in Delhi include Vigyan Bhawan, Delhi High Court, Flyovers and TV Tower etc. Several projects to his credit in other parts of the country include Chimneys and Coal Handling Units for Thermal Plants, Water Treatment Plants, Irrigation Projects, Roads and Bridges etc. He has also executed a number of projects abroad which include Hotels, Flyovers, Educational Building Complexes etc in Iraq and Highway projects in Nepal. After superannuation from Government Service, his services are being utilized by the Government and other organizations for policy and strategy issues. He was expert member of the group formed by World Bank to study the procurement procedures in Government of India. Another important World Bank project handled by him was establishment of medical sub-centres in the country. He headed a Policy Level Committee for Delhi Metro Project and was a member of a similar committee for National Highways Authority of India. He has been invited as a guest faculty by national level training organizations. He has actively contributed and remained involved with The Institution of Engineers (India) for the last more than 25 years. He is Council Member of The Institution of Engineers (India) since 1992 and was Vice President in 1999-2000.He is also associated with number of other professional bodies of the country and abroad. He is founder President of the Indian Buildings Congress. Presently, he is the President of International Council of Consultants. He has also remained Vice President, Indian Roads Congress. He has several awards to his credit which includes Outstanding Engineer Award given by The Institution of Engineers (India) at Delhi and Roorkee.

Shri B J Vasoya

President 2004-05

Presidential Address

It is my proud privilege and honour to be amidst a galaxy of distinguished dignitaries, leaders of engineering sectors, luminaries of the academic world and the engineering professionals from various parts of India and neighbouring countries for inauguration of the Nineteenth Indian Engineering Congress, being organized by the Maharashtra State Centre of the Institution of Engineers (India).

I am extremely thankful to all the members of the Council of the Institution of Engineers (India) who have elected me unopposed and unanimously to the highest position of the President of this largest professional body of engineers in the country, probably the largest body of engineering fraternity in the world. I assume the office of the President with the greatest respect and humility. I know that the Institution is facing many serious problems and I assure all the Corporate Members and the Council that I will do my best to reciprocate to the faith bestowed on me by all of you. I look forward to the continuous support and cooperation of my distinguished colleagues in the Council and all the fraternity of engineers at large.

I am further gratified and delighted by the presence of most of the Past Presidents of the Institution and I am hopeful that with blessings and unending cooperation from them, I shall be able to shoulder the responsibility that has been reposed in me.

Let me take this opportunity, on behalf of all of you as well as on my own behalf, to congratulate and thank the retiring president Shri O P Goel for very ably conducting the activities of the Institution by opening many horizons of activities which have raised the name of the Institution at the highest levels in the State Governments and the Union Government.

HISTORY OF THE INSTITUTION OF ENGINEERS (INDIA)

This Institution has the illustrious history behind. During the First World War (1914-1918) and immediately thereafter, the engineering activities took a positive shape in India. A significant number of Indian engineers and British engineers were engaged in the country in many capacities. The Government of India formed an Indian Industrial Commission under the Chairmanship of Sir Thomas Holland, the then Commerce Minister of the Government of India. He strongly recommended the establishment of an Institution of Engineers to play the important role for various developmental activities.

REGISTRATION OF THE INSTITUTION

After a series of meetings at Shim la, Calcutta, Bombay and other places, it was decided to form an Indian Society of Engineers consisting of all branches of engineering science. The rules and regulations were framed by Major J H Willy and the memorandum of association, articles and Bye-Laws were finally delivered on November 3, 1919 by the firm of solicitors - Walker and Graham. The Institution of Engineers (India) was then registered at Chennai on September 13, 1920 and the first Annual General Meeting was chaired by His Excellency Lord Chelmsford, the then Viceroy and Governor General of India. Sir Thomas R J Ward became the first President of the Institution of Engineers (India) .

GRANT OF THE ROYAL CHARTER

The Royal Charter was granted to the Institution on September 9, 1935 at Buckingham Palace by His Majesty the King and Emperor George V. The grant of the Royal Charter was an outstanding event in the history of The Institution as it was the first such recognition to a professional body in India. This endowed the corporate members of The Institution of Engineers (India) with the right to use the title 'Chartered Engineer'.

OBJECTIVES AND PURPOSES

The Royal Charter identified objectives and purposes for which The Institution of Engineers (India) was established. They are:

- To promote and advance science, practice and business of engineering in all its branches in India.
- To establish, subsidize, promote, form and maintain local associations of members belonging to the Institution to enjoy the rights and privileges of the Institution by holding of conferences, by the publication of papers, periodicals or journals, books, circulars and maps or other literary undertaking.
- To promote the study of engineering with a view to scientific and economic development of engineering in India.
- To establish, acquire, carryon, control or advise with regard to colleges, schools or other educational establishments for sound education and training in engineering
- To give the Government of India, the Local Governments and Municipalities and other public bodies and others, facilities for conferring with and ascertaining the views of engineers as regards matters directly or indirectly affecting engineering .
- To promote efficiency and just and honourable dealing and to suppress malpractice in engineering.

BLESSINGS OF THE NATIONAL LEADERS

This Institution had the privilege of blessings and goodwill from national leaders:

Lord Irwin, the Viceroy and Governor General of India, laid the foundation stone of the

Institution building in 1930.

The new building of Central India Centre was inaugurated by Shri CD Deshmukh, the then Finance Minister, Government of India, in presence of Late Lal Bahadur Shastri, Shri K C Reddy and His Excellency Dr Rajendra Prasad, the then President of India.

His Excellency Late Dr Sarvapally Radhakrishnan, the then President of India, unveiled the statue of Bharat Ratna Sir Mokshagundam Visvesvaraya, the doyen of Indian Engineering, at The Institution of Engineers (India), Hyderabad, in November 1966.

Late Pandit Jawaharlal Nehru, the first Prime Minister of India, accompanied by Dr K L Rao and Mr D P R Cassad, visited Delhi State Centre of the Institution of Engineers (India).

The new headquarters building at 8 Gokhale Road, Calcutta (now Kolkata), was formally opened by His Excellency Dr Zakir Husain, the then President of India, in 1968.

The First Indian Engineering Congress was held at Calcutta (now Kolkata) and was inaugurated by Late Rajiv Gandhi, the then Prime Minister of India, in 1987.

STATUS AND STRENGTH

Currently, the Institution is spread over 94 state and local centres across the country and it has over 5,00,000 members. It includes all the branches of engineering such as (a) Agricultural Engineering; (b) Architectural Engineering; (c) Aerospace Engineering; (d) Chemical Engineering; (e) Computer Engineering; (f) Civil Engineering; (g) Electrical Engineering; (h) Environmental Engineering; (i) Electronics and Telecommunication Engineering; (j) Mechanical Engineering; (k) Metallurgical and Materials Engineering; (l) Mining Engineering; (m) Marine Engineering; (n) Production Engineering; and (o) Textile Engineering.

Thus, it is :

- A far-flung multi-professional society with a large and often high-profile membership base.
- A wide range of scholarly publications for dissemination of research results and technical knowledge.
- Membership (as National Member) of international bodies, such as WFEO, WEC, WMC, FIP, fib, and FIESCA .
- High international standing with bilateral links with 23 nations or national organizations. The largest open university for non-formal engineering education probably in the world.
- Additional infrastructure for education and training at the Engineering Staff College of India (ESCI), Hyderabad.

EXAMINATIONS FOR SECTION 'A' AND SECTION 'B'

The Institution holds qualifying engineering degree examinations to provide an opening for higher education to the personnel engaged in engineering activities who could not avail of formal college education earlier. The Institution has also introduced the post-graduate programme and the examinations for the same are also conducted. The rules and syllabi were framed in 1924 and subsequently revised as guided by All India Council for Technical Education (AICTE) and approved by the Government of India from time to time. About 70,000 students appear in the examinations annually and the Institution has a full network of paper-setting, conducting examinations at different centres all over the county, evaluation of papers and to declare the results through its Education, Examination and Accreditation Committee (EEAC) and the Examination Disciplinary Committee (EDC).

PUBLICATION OF JOURNALS

The Institution publishes Journals consisting of latest technical papers for all the disciplines to keep the Corporate Members fully briefed about the latest developments in engineering science and technology. The Institution organises, at different Local and State Centres allover the country, Seminars, Lectures and also celebrates the Engineers' Day, Water Resources Day, World Telecommunication Day, World Environmental Day, etc.

TECHNICAL SUPPORT TO THE GOVERNMENT AND NON-GOVERNMENT ORGANISATIONS

The Institution is to impart the technical support and guidance to the concerned departments of the Central Government, State Governments and Municipal Corporations and other such bodies as per the needs. For example, the Government of India appointed a Task Force at the highest level for providing water to the deficit states from the surplus water states by inter-linking of rivers. This is a huge task where issues for its advantages and disadvantages including the environmental impact are concerned. The Task Force has requested the President of the Institution of Engineers (India) to provide help at various levels. A Special Committee has been appointed to help the Task Force.

EXPANDING THE ACTIVITIES FOR THE SERVICE TO THE PUBLIC AT LARGE

The aims and objectives of the Institution of Engineers (India) as per the Royal Charter are to serve for the betterment of the engineering fraternity as a whole and to keep them updated with the information of latest research and development in the fields of engineering. Probably, this Institution with the strength of over 5 lakh technical people as members is the largest in the world But because of advances in telecommunication and other sectors, the world has become small. But the latest technology is available mainly for the urban population. The gap between the rich and the poor continues to expand. The experience shows that the rich are becoming richer and the poor are becoming poorer. Therefore, the need was felt to try to help the rural poor and downtrodden people by whatever way the Institution of Engineers (India) can reach to the people and understand their problems and provide whatever technical help is possible. The Institution has taken many focussed initiatives towards this and to serve the engineering profession in the form of separate Fora.

WATER MANAGEMENT FORUM (WMF)

Water is the supreme necessity for the human being to live. Availability of the drinking water is fixed over the world and the demand increases due to the increase in population and due to increase in the industrial development, etc. Therefore, the quantity of water is continuously becoming scarce day by day. We have seen that there are fights between states and in the past, countries have even fought wars over water. The need of the hour is to save and store every drop of water in urban as well as rural areas and use it economically.

The professionals of The Institution of Engineers (India) visit villages to train the rural people about to how to store the rain water by adopting different devices. For bigger storage, all the people from the village unite and build their check dams and store water for benefit of their crops to be irrigated by lifts and recharge of the wells. This is known as 'Gandhian Shram Yagna' which will make them self-sufficient in water.

We also know that very large quantity of water goes waste to sea through many rivers. Recently the efforts have been started at the Government of India level on inter-linking the rivers for various zones. Water can be diverted from the surplus water states to those with water deficit. This way, those with surplus can avoid inundation and flood damages, while others can benefit from increased availability. There are many issues in the proposed project involving factors relating to environment, rehabilitation, resettlement and lands, etc. But they can be amicably resolved if various states and regions decide to co-operate.

The taskforce constituted by the Government of India has asked the help of The Institution of Engineers (India) in different fields of engineering. The Institution of Engineers (India) has constituted a committee of experts and dignified engineers on the inter-linking of rivers to provide support to the taskforce in the different fields of engineering.

RURAL DEVELOPMENT FORUM (RDF)

The Institution has established the Rural Development Forum (RDF), which takes care of various issues related to life of the villagers. The Institution's professionals identify villages, discuss issues with the local population and provide guidance on healthcare, sanitation, road construction, water supply, etc by the dialogue with the concerned authorities.

VOCATIONAL TRAINING CENTRE FOR THE RURAL SECTOR

One of the major initiatives of the RDF is in the form of setting up of a vocational training centre in a village Bandipur in Hoogly district of West Bengal at the cost of over Rs. 20 lakh. The UK based NGO, Engineers Against Poverty (EAP) is actively collaborating by providing part financial assistance for the project. The vocational training centre shall provide opportunity of training the people in the villages in the relevant vocations for their upliftment and creating gainful employment opportunities.

SUSTAINABLE DEVELOPMENT FORUM (SDF)

Since the Earth Summit of 1992 at Rio de Janeiro, nations have acknowledged the need to be more alert in protection in environment and in taking protective measures to avoid deterioration in flora and fauna, biodiversity etc. However, this is not enough as the accelerated rate of damage is such that we are facing the global warming and there are reports of 'acid rains' due to the damage in the ozone layer. The pollution levels in different cities in India are also increasing at a faster rate, challenging the existence of the human being itself! Therefore, the entire engineering fraternity, especially young engineers have to rise quickly to reverse the trend of environmental damage. The problem should be given the highest priority by the Union Government and the State Governments before it becomes too late. I assure that The Institution of Engineers (India) will not lag behind in performing its duties .

SAFETY AND QUALITY FORUM (SQF)

The Institution has set up the Safety and Quality Forum. Its aim is to network with various national, regional and local government bodies and organizations and inculcate the concept of safety and quality in operations of mines, construction industry, factories, etc.

NATIONAL DESIGN AND RESEARCH FORUM (NDRF)

The Institution has also established National Design and Research Forum to promote, design and research activities in the country. The forum acts as facilitator and promoter in engineering design and research. Many design and research initiatives in cutting edge technologies areas have involvement of this Forum,

ENGINEERING STAFF COLLEGE OF INDIA (ESCI)

Engineering Staff College of India is a unique institution set up by the apex body of engineers in the country in October 1981. Its avowed objectives are imparting profession-specific, need-based, continuing engineering-cum-management education and training programmes in frontier areas, and providing professional consultancy services, and taking up of sponsored research programmes.

The core faculty of ESCI covers all major engineering technology and management disciplines. Currently, they are paying special attention to Emerging Technologies and Strategic Management, Materials and Structures, Computer Applications and Information Technology, Power and Energy, Water Resources, Quality and Productivity Management and Technology, Control and Instrumentation, Urban and Rural Development and Environment and Eco-systems.

STATUS OF THE ENGINEERING PROFESSION

Basic requirements of the human beings are fresh air, potable water, foodgrains, cloth to wear and house to reside. These requirements vary between urban and rural populations. The engineering technology attempts to make available the basic requirements. People need good sanitation for their stay and facilities to enjoy better health and medical treatment. Equipment and machinery to provide water to irrigate the crops, to manufacture fertilizers for increased production of food, for manufacturing cloth, construction of houses, production of medicine and surgical equipment for medical treatment etc are also essential. These are the devices of engineering and technocrat skill. Similarly the transport by railway, trucks, car, aircraft, missiles and other artillery for wars are creation of engineers.

Every human being is fully dependent on the benefits of the engineering devices and they are so much interwoven that they have forgotten to recognize the engineering profession and not only that but its visibility to the public is rarely realized. Most of the socio-economic development is due to the contribution of the engineering fraternity.

In spite of that, it is not understood why engineers and technocrats are not recognized by the top level political leaders and administrators .

I would like to recall the challenge accepted by Late Pandit Jawaharlal Nehru, the first Prime Minister of India, to make our country self-reliant in food production. We remember that we were dependent on inferior quality of wheat supplied to India by the US under the PL 480 scheme. Panditji encouraged engineers and technocrats and launched 'Green Revolution'. Engineers from various disciplines united and worked in support of the challenge and many BHAKRA NANGALS were constructed and many fertilizer plants, steel and other heavy industries were built. Political leaders used to call these structures 'monuments and temples of the modern India'. Engineers innovated hybrid seeds, fertilizers and mechanized agriculture and our country became self-sufficient and started exporting wheat and rice within the period of 10 years. The engineers and technocrats were treated as national wealth. Subsequently, however, the status has been gradually declining.

When there are disasters like earthquake, famine, flood havoc, breach of roads and bridges during rains and dislocation of railway track; engineers and technocrats are the main force to come to the help and work without taking caring for personal safety. There are examples of engineers from National Highway Organization being killed and also National Hydropower Corporation engineers being kidnapped. Still, engineers have unflinchingly continued to do their duty.

During the last decade, the former Prime Minister Shri Atal Bihari Vajpayee decided to provide better roads for efficient transportation by linking Kashmir to Kannyakumari and Silchar to Somnath and the Golden Quadrilateral (GQ) projects. Indian engineers and technocrats have proved themselves successful in delivering international quality roads in a short span of time. If the bird's eye view is taken over Bombay and New Bombay area, the series of curvilinear bridges look like new-age monuments. The credit again goes to the engineering profession.

Some of the states of India have realized and appointed engineers/technocrats in the administration at the highest posts like that of secretary of departments like Roads and Buildings, Water Resources and Water Supply and Sanitary. The performance reviewed by the senior bureaucrats has been found excellent. Gujarat has adopted this practice for more than 20 years. Maharashtra has also adopted this practice and the experience found by the leaders is good. Technocrats have provided global standard infrastructure network to the States of Gujarat and Maharashtra. Probably this is the reason that the economic growth of these two States is top ranking in comparison to other States of India.

At the national level, Late Prime Minister Mrs Indira Gandhi recognized the skills, selected and appointed an engineer, Dr C C Patel from Gujarat, as the First Secretary of Department of Irrigation and Power in Government of India.

DESTINATION 2020 : INDIA—A DEVELOPED NATION

The Institution of Engineers (India) for this Engineering Congress has selected the theme as Destination 2020 : India — a Developed Nation.' Its aim is to see India as a fully-developed nation by the year 2020. The task is very gigantic and challenging. If the political leaders and administrators put full confidence on engineers and technocrats, India can become economically sound with the use of latest technology and engineering devices and also the best use of the talents of India. We have learnt that in spite of cut-throat competition between countries for telecommunication systems, India has surpassed everyone and our technocrats have made the world very small by connecting each and every village of India by telephone. This is also a revolution achieved by the world-renowned engineering wizard, Dr Sam Pitroda.

Another aspect is to stop the draining away of our talents in information technology and computer to the western countries. We have to persuade such highly brilliant technocrats to remain in India by honouring them and paying better than the western countries. The result of such action will be known after few years.

In spite of the above glorious history of the engineers and technocrats, engineers feel lack of support system. Their justified capabilities need to be recognized and appropriate status needs to be provided. I appeal to the .engineering profession and the entire fraternity to unite without getting frustrated and continue 'Sang harsh' till satisfactory results are achieved, Our slogan should be, 'Sangharsh Hamara Nara Hai'.

Let me recall Ralf Smith, who said: Engineering is the professional art of applying science to the optimum conversion of natural resources to the benefit of man.

ENGINEERS BILL AND ENGINEERS MOBILITY FORUM

Lastly, the Engineers Bill has been submitted by The Institution of Engineers (India) to the Ministry of Human Resources Department for certain regulations. It is in the interest of the engineering fraternity that the Bill is converted into an Act to facilitate further growth of the profession. We need the support of all leaders, administrators and well-wishers in getting it passed in the Parliament.

Moreover, in view of the WTO and GATS regime of globalisation, the world engineering profession has to unite and work for the quality as the professional competence of engineers needs certification for national in international mobility. The international norms for registering Professional Engineers across the globe have been framed by The International Body, the Engineers Mobility Forum (EMF). The Institution has been granted provisional membership of the Engineers Mobility Forum at its meeting in 2003 in New Zealand. The Institution, therefore, has the responsibility of implementing the systems and procedures of registering of engineers in India. In this major endeavour, other professional organizations too have important role to play and jointly the process has been set in motion. This will give the eligible Indian engineers international mobility and equal status world wide.

This major task can be achieved only with active co-operation and support of other professional bodies and engineers.

I wish the engineering profession is recognized and given proper status which will make India a super power country in the world in time to come.

JAI HIND

Shri B J Vasoya—a Brief Profile

Born on November 13, 1929 in Jamnagar (Gujarat), Shri Bhagwanji Jethabhai Vasoya, FIE, obtained his Bachelor's degree in Civil engineering from the M S University Baroda (now Vadodara) in the year 1953. He then worked till 1979 with the Public Works Department, Government of Gujarat, in various capacities and was responsible for investigation, design and construction of a number of earthen dams, masonry dams, bridges, canals, etc. He further worked as the Chief Engineer and the Joint Secretary to the Government of Gujarat, Department of Irrigation, from 1979 to 1987. He successfully handled the Sardar Sarovar Project on the river Narmada, which is the single-largest canal project in the world covering 86 lac acres of land under command. Shri Vasoya was responsible for designing the world's biggest canal system of 40,000 cusecs with automatic operation for the main canal and with hydraulic operation for the major branch canals, along with the manual operation for the distribution system. He was elevated to the rank of Secretary to the Government of Gujarat, Department of Irrigation, in the year 1987 and got superannuated the same year. Since then till 1995,Shri Vasoya worked in various capacities, such as the Advisor, Department of Water Resources, Government of Gujarat; as the Chairman and Managing Director, Gujarat State Construction Corporation; and also as the Chairman of the National Environmental High Power Committee of the Government of India. The Committee contributed a lot in finalizing the standards and norms for environmental impact assessment with regard to setting up irrigation and power projects in the country. Shri Vasoya was also instrumental in the construction of the world's longest road-cum-railway bridge in the sea across the Gulf of Cambay in Gujarat and also a 200 km-Iong drinking water pipeline, from the river Narmada to the draught-prone areas in Saurashtra, carrying 150 million gallons of water per day. The Government of Gujarat had also appointed Shri Vasoya as One-man Commission to review the project proposal from a Dutch company for providing navigation in the river Narmada and the Narmada main canal. Shri Vasoya is presently the Chairman of La-V-Jay and Associates Pvt Ltd and Tricot International Ltd, Ahmedabad. Shri Vasoya has been associated with the Institution in various capacities, such as the Founder Member and also the Chairman of the Saurashtra Local Centre; Chairman of the Gujarat State Centre (1992-1994); Chairman of the Water Management Forum—a peripheral body of the IEI (1996-2002); and a sitting member of the IEI Council representing the State of Gujarat. Shri Vasoya is a widely travelled personality, having visited countries like France, Netherlands, Belgium, Brazil, USA, UK, Holland, Switzerland, Italy, Singapore, Malaysia, etc on various assignments.

Prof (Dr) S C Naik

B Tech (Madras), M S (Ottawa, Canada), Ph D (Wales, UK), MISTE, FIIChE, FIE, C Eng(I), P Eng(I)

President 2005-06

Presidential Address

INTRODUCTION

I feel most honoured to be amidst a galaxy of distinguished dignitaries, leaders of engineering profession, doyens of academic and R&D world and captains of industries from all parts of the country and even from neighbouring countries, who have assembled here for inauguration of the Twentieth Indian Engineering Congress — the apex technical activity of The Institution of Engineers (India), IEI — being organized by West Bengal State Centre at Kolkata, the "City of Joy". I express my sincerest thanks to all the Members of the National Council of IEI, who have bestowed their confidence by electing me as President of this great Institution. I am aware of the tremendous responsibility and accountability that go with this high office. I shall try most sincerely to meet the expectations. I seek wholehearted guidance and co-operation from all the Past Presidents and also from my colleagues in the Council. I expect the Secretariat to help continually. I take this opportunity to invite the entire fraternity of engineers to send their suggestions for shaping this premier professional body to a "Vibrant International Society" of engineering profession.

I take this opportunity to convey my personal gratitude to the outgoing President Shri B J Vasoya, who during his tenure so ably guided the multifarious activities of IEI. On this auspicious occasion, I pay humble respect to my illustrious predecessors, who by their exemplary service, selfless dedication and mighty professional acumen not only enriched the engineering profession but also helped India to unfold her immense treasure by judicious applications of both natural and human resources admixture with fruits of scientific developments.

The status of engineering profession in India became a matter of higher importance during 1916-18 and it received public prominence in the Report of the Industrial Commission. There were endeavours to advance an industrial society to safeguard and assure the status of the profession. Sustained efforts by a group of Indian and British Engineers brought "The Institution of Engineers (India)" into being and the Institution was registered on September 13, 1920 under the Companies Act of 1913 with Madras as the "Province of Registration". The Registered Office was shifted to Calcutta on November 11, 1920. In recognition of valuable services for the cause of advancing the engineering developments, the Institution was granted the Royal Charter in 1935. With this modest initiation, this great Institution has been progressing well and is engaged in multifarious developments towards the growth of engineering profession in the country. As of date, there are 94 State and Local Centres with a membership strength of nearly 500000, out of which nearly 100000 are of Corporate Grade. We have six Overseas Chapters and bilateral relationships with 23 sister professional societies of international repute. Fifteen engineering disciplines in addition to one "Interdisciplinary Co-ordination Committee" have been conducting various technical discourses throughout the country with a strong zeal to enrich technical knowledge of our members in particular and the entire engineering community in general in order to transform the society into a knowledge based one. This endeavour would surely help India to mitigate the damage posed by any sort of natural calamity and also upgrade the quality of life of common people through mission-oriented tasks.

The Institution is pioneer in the field of non-formal engineering education in the country. During 1928, when the infrastructure of Indian Education was inadequate, the Institution at its wisdom coupled with a visionary view started conducting Sections A and B Examinations in engineering disciplines with only four candidates. With the passage of time, the strength has increased manifold and at present, nearly 70000 aspirants each year appear in the examinations. This examination is considered to be the oldest, yet the most promising non-formal engineering examination in the country and the pass-out candidates have highest acceptance by industry and academic institutions both in India and abroad. I consider this endeavour of the Institution as a national pride since we are adding nearly 2000 professionals each year. This course is attracted especially by those who are in the profession at lower tier as technicians and diploma holders. Compared to formal education in engineering, this mode is more economical and, therefore, the weaker section of the society can afford the cost of this education system that is recognized by the Ministry of Human Resources Development, Government of India. The pass-out students are considered as equivalent to engineers graduating from National Institutes and Universities. The Institution also offers Postgraduate Programme for practicing engineers in five disciplines in non-formal mode. After successful completion of two modules of the same programme, IEI awards Diploma to the successful candidates and subsequently passing the third module of the same course, the Masters' Degree in respective engineering discipline is awarded by Birla Institute of Technology, Ranchi, (a Deemed University) with whom the institution has a MoU.

The Institution, besides fulfilling its prime objective; has created certain Fora to meet the challenges on specific areas of national interest. Since their inceptions, these learned bodies have been playing pivotal role towards fulfilling the aspirations of the society at large. These Fora, which are autonomous in functioning, have specific domain of activities. Due to their noteworthy contributions, these Fora are considered not only as national assets by the planners of this country but also they are often given high order of responsibilities to undertake mission-oriented tasks of technical nature.

Engineering Staff College of India, ESCI

Established in 1981 at Hyderabad, the Engineering Staff College of India, ESCI operates throughout the country whose prime objective is to organize various technical discourses in diverse engineering fields in order to upgrade the knowledge of practicing engineers and technologists engaged in the profession, The training is provided to beneficiaries drawn from industries, government and academic institutions with a view to enrich the technical knowledge of individuals so as to improve the contemporary skills for better productivity, The ESCI also executes consultancy jobs, Let our goal be to make it a Deemed University.

National Design and Research Forum

Established in 1985 at BangaJore, the National Design and Research Forum, NDRF encourages and disseminates amongst members and nonmembers the information on all matters pertaining to engineering design and research on priority areas and thereby propagates the indigenous concepts in the relevant fields of engineering, The NDRF gives awards to our students and to prominent designers and R&D experts.

Rural Development Forum

Established also in 1985, the Rural Development Forum, RDF operates from Kolkata. The prime objective of this Forum is to upgrade the quality of life of poor people living in rural India by absorption of fruits of scientific developments coupled with appropriate and low-cost technologies along with available local resources.

Water Management Forum

The Water Management Forum, WMF established in 1986 at Ahmedabad extends technical expertise to beneficiaries in order to conserve water resources and also implementation of water management techniques so as to use water optimally and maintain water quality.

Sustainable Development Forum

Established in 1998, the Sustainable Development Forum, SDF operates from Patna. This Forum propagates the message of sustainable development. which is the core issue of all developments. The inner sprits of eco-centric societies should be respected while finalizing techno-centric developmental projects.

Safety and Quality Forum

The Safety and Quality Forum, SQF at Delhi was established in 2003. The main purpose of this Forum is to promote safety and quality awareness in engineering operations in general and inculcate the sprit of bringing safety and quality in all engineering operations in particular.

The Institution observes the Engineers' Day every year on 15 September, the birth day of Bharat Ratna Sir Mokshagundam Visvesvaraya, on a central theme of national importance. Based on the deliberations on this topic throughout the country, the Institution crystallizes a set of recommendations which is then forwarded to the concerned departments and industries for effective implementation. On an average the Institution holds nearly 350-400 technical discourses under the purview of all engineering disciplines throughout the length and breadth of the country in order to upgrade the knowledge of professionals. The Institution holds every year the Indian Engineering Congress where experts in the field debate a contemporary engineering problem of national importance at length with emergence of recommendations based on engineering inputs to tackle the concerned area. The Institution also awards scholarship to engineering students at degree and diploma levels. It gives away each year Certificates in a Convocation to successfully pass-out Section A and B Students. A Convention on a suitable theme of national interest is held at the time of Convocation.

In the international arena too, this great Institution has been playing a leadership role towards shaping the engineering profession of tomorrow's world and thereby projecting its visibility in the international arena. The Institution is represented in various international professional bodies including holding the Chairmanship of the Committee on Engineering and Environment, CEE, and also the Vice-Presidentship of World Federation of Engineering Organisations, WFEO. It is the founder member of several international bodies including World Mining Congress, WMC, Poland; World Energy Council, WEC, UK; Federation Internationale du Beton, fib, Switzerland, and Federation of Engineering Institutions of South and Central Asia, FEISCA. It provides technical inputs to both State and Central Governments. Following the emergence of World Trade Organization, WTO in 1995 and subsequently the introduction of General Agreement on Trade and Services, GATS, the mobility of engineers throughout the world is under scanner and IEI being granted the Provisional Membership of the Engineers' Mobility Forum, our utmost attempt would be to upgrade the Membership status to Permanent in nature by putting our best technical inputs. Let this be our immediate and sacred goal. Friends, I would have liked to share with you many thoughts concerning the profession. The time being short, I propose to confine myself to some ideas on "Challenges and Opportunities of Engineering Profession in the 21st Century".

ABSORPTION OF STATE-OF- THE-ART -TECHNOLOGY

The industrial landscape in India has been going through a phenomenal change over the last decade. Entrepreneur-driven and globally networked industrial enterprises are fast becoming the emblems of a vibrant India. This transformation has made a paradigm shift in manufacturing base of our country, which underscores the sprit of self-reliance in all sectors of engineering manufacturing. This situation promises a better economy in days to come. With a rapid development of economy during the last few decades after the advent of industrialization and globalization of economy and also the country being the second largest populous one, it has a huge internal potentiality. To exploit this situation, manufacturing sectors should produce their goods using the state-of-the-art-technology and product should be economical and long-lasting. The unorganized sectors, that is, the small scale and the medium scale industries which contribute the lion share of our manufacturing base should identify the inherent technical problems and upgrade their functioning with the absorption of state-of-the-art technologies wherever possible at the earliest.

According to recent statistics, after a decade or two, India will have the highest number of youths below the age of 30 whereas the situation of the same will be completely opposite in the developed countries. Having a huge base of engineering manufacturing industries in India, with availability of huge pool of trained manpower in every field of operation, the country would be in a position to produce not only its own needs but also help others to meet their requirements. To achieve such an opportunity, the captains of Indian Engineering Manufacturing Sectors should draw a long-term road map keeping in view the micro requirements of each sector at the earliest with a time-bound programme to grab the challenge and convert the same to an opportunity. IEI can playa catalytic role in the form of identifying the inherent technical problems of this sector and recommend those to concerned research establishments and industries to overcome their problems in order to usher an era of mutual existence so as to broaden the manufacturing base of India and thereby improve the country's economy at large.

SUSTAINABLE DEVELOPMENT

According to UNO statistics, entire world population of 6 billion is divided into three broad categories, poor (4 billion), transitional (1.2 billion) and rich (0.8 billion). People of developed world live in utilizing adequate natural resources as against substantial low per capita consumption of the same commodities in poor countries. To meet the reasonable life-style, the average per capita consumption of energy by the developed nations is much higher as compared to rest of the world. The population increase in poor countries is also alarming as against the developed nations and that leads to wide variation of life-style of people living in other nations. Despite having huge natural resources by many of the poor and developing countries, the quality of life of common people in these countries have not improved substantially over a period of time due to utter negligence of approved long-term policies coupled with judicious utilization of natural resources and human skills. To achieve a striking balance in this mis-match, the entire human community should propose and demonstrate sustainable pathways towards. achieving the long-term policies for shelter, food, clothes, health, drinking water, sanitation, education, etc keeping in mind the importance of both natural and human resources locally. This is in line with the aims and objectives of UN Millennium Development Goal, MDG.

The above vigorous task should be attempted in two distinct but mutually supporting models, namely, (i) macro downwards, and (ii) micro upwards. The former calls for participation of all countries irrespective of richness in their natural and human resources under broad consensus guidelines decided after a series of thoughtful dialogues between all stake-holders towards protecting the general interests, namely, environment, education, absorption of green technologies, etc which are being monitored by world bodies like UNEP, Washington Accord and WTO. The latter model underscores the importance of specific needs of a country or a group of countries or a region to concentrate more on time-bound and mission-oriented programmes to cover up the backlog. I am sure if these two models function for a reasonable period of time with mutual support to each other and obviously without any political or religious bias and purely on scientific approach, the mis-match being noticed at present would be marginalised substantially, if not eliminated completely.

The Institution through its Forum SDF propagates the core message of sustainable development and conducts various technical programmes throughout the country with a view to bring awareness on this vital area of development. I believe the engineers have specific role to integrate development with the enrichment of human quality index, which is the root of progress of a society. The role of engineer against poverty, EAP should always be highlighted in all developmental projects, especially in third world countries. With this backdrop, I appeal to all assembled here that you should not be stake-holder of any developmental plan that would sacrifice the basic needs of our posterity. I feel tempted to quote Mahatma Gandhi who once said:

" .... the world has enough for, our needs but not for our greeds .... ".

INFRASTRUCTURE DEVELOPMENT

Infrastructure Development is the index through which the development of a nation is mapped. After severe apathy in this core sector of national importance for a prolonged period, very recently the mind-sets of planners both at the central and the state levels have changed. Initiation of Golden Quadrilateral and Diagonal is one such testimony. In telecom and software sectors also, the Government has unfolded its multifarious plans and has allowed private participation in various core sectors to compete with public utility companies. This transformation has brought anoticeable impact in the mind-set of consumers mainly due to absorption of appropriate technologies that extends value-added services to consumers at affordable cost. This invites a cutthroat competition that was totally absent a few years back. Aviation industry and Ports in the country are also in the process of re-engineering after a long gestation period of apathy. The early dividend of this change has become visible both in the form of emergence of huge domestic market and that too at affordable cost. These phenomenal changes have occurred mainly due to opening Up of our economy with utmost attempts by technologists in the form of identifying appropriate technology in respective fields of operation and subsequently implementing those for higher productivity.

"India lives in village" that accounts nearly 70% of our population. Unless we reinforce the rural economy with all the facilities available in urban India, the migration of people from rural to urban area will not cease permanently. It is imperative to bring all the services to the doorsteps of rural India at an affordable means. This is a Herculean task for the Government alone and it is the duty of every citizen in this country to appreciate the problem and extend all possible help to our planners to achieve the target. I want to mention here that Indian Tobacco Company, ITC, an organization of national repute with international existence has started functioning through some of its rural hubs with active participation of local farmers as stake-holders. These stake-holders generally sell their produces in these hubs instead of sending to urban market and thereby getting higher return as compared to the earlier margins. It is the duty of all professionals engaged in various fields of infrastructure to complete the assigned projects without time and cost overruns and that too, with the admixture of green technology along with local resources.

The RDF, a peripheral body of IEI, has been playing the catalytic role in identifying the needs of rural India and simultaneously suggesting the engineering inputs for workable solutions to the identified problems. The link between the planners or executors at the one hand and the professional expertise on the other hand will surely bring a win-win situation in near future under the able guidance of IEI.

TECHNICAL EDUCATION

Before 1976, education was the exclusive responsibility of the States. The Constitutional Amendment of 1976, which included education in the Concurrent List, was a far-reaching step. The substantive, financial and administrative implication required a new sharing of responsibility between the Union Government and the States. While the role and responsibility of the States in education remained largely unchanged, the Union Government accepted a larger responsibility of re-integrating the national and integrative character of education to ensure quality and standards. The Technical Education System in the country covers courses in engineering, technology, management, architecture, pharmacy, etc. The Ministry of Human Resources Development caters to programmes at undergraduate, postgraduate and research levels. The All India Council for Technical Education, AICTE, a statutory body, looks after planning, quality and development of technical education system. At present, we have a network of nearly 2000 degree institutes approved by the AICTE. In the broad sense, education can be considered as a "Set" in term of mathematics, which consists of a large number of sub-sets or elements. Technical Education is one such sub-set. The approved AICTE institutions are providing the Formal Technical Education in the country. However, IEI is the largest producer of technical manpower through non-formal mode in the world. The radical and critical thinkers like Paulo Friere, Ivan Illich and Philips Coombs have explained how the formal systems have failed and how the need has come for more of open learning in a system of life-long education that spreads over the period from "womb to tomb". Nobel Laureate R N Tagore in this connection once said: 'A teacher can never truly teach unless he learns always'.

The country witnessed a phenomenal growth in the area of technical education during the last decade in terms of establishment of a large number of academic institutions with the active support of private investments. This transformation has opened up a paradoxical situation in real term of widening the strong education base in the country. Within a very short period of time of their existence, many of these institutes are under the scanner of AICTE for violating norms. In many cases, strong actions have been initiated by the statutory body and in some cases even the recognition given to the institutions has been withdrawn. This is due to shortage of enough trained technical personnel coupled with unilateral decisions violating the very concept of aims and objectives of the change. The attempt of this transformation has been made without giving proper thought for widening the education base for diploma holders and technicians at the bottom tiers of the pyramidical structure of our education model. The changes in upper two tiers, namely, for graduates and post graduates have made the bottom tiers weaker. This alarming situation should not be allowed to continue for a longer period and corrective measures are to be taken at the earliest. However, some private players have been displaying extraordinary performances in this core sector. In recognition of their excellent services, they should be given adequate supports by all to have an integrated approach to make a paradigm shift of our technical education base with competitive edge of knowledge sharing with the International knowledge hubs. I like to mention here that 34% and 28% of employees in Microsoft and IBM, respectively are Indians. Similar pictures can also emerge from major multinational companies in the world, especially in the field of IT. Indian Universities, National Institutes and Engineering Colleges are doing commendable jobs not only in core engineering education but also in emerging fields of engineering, namely, IT, Biotechnology, BT, Nano Technology, Material Science Engineering, Earth Science Engineering, Corrosion Engineering, Ceramics Engineering, Space Engineering, Deep Sea Engineering, etc. I am confident that within a decade or two, Indian engineers would show similar success in other frontier areas of engineering which they have already displayed in IT sector.

The Institution right from its inception has been playing a crucial role towards strengthening the. mission of propagating the technical knowledge in the country. During last 25 years, the Institution has produced more than 25 000 professionals, who are working in diverse fields. I consider this as our best contribution to the nation. Besides this major contribution by a body like ours, the Institution is the largest professional society in the world which extends supports to its members and non-members in order to update their continuous professional development, CPD. This process helps the professionals to enrich their contemporary engineering skills through various technical programmes. This mammoth job would surely help the country to have a huge pool of productive engineers to shoulder any challenge posed on them.

ENERGY SENARIO

The Indian energy sector is facing one of its most difficult periods since independence. The demand for power has been accelerating at a high rate while supply has been unable to keep pace resulting in huge shortage. Capacity additions in recent plan periods have been far away from the projected figures leading to a further widening of the gap between demand and supply. Initiative towards private participation in this core sector has not yielded sufficient dividend though a modest beginning has been made since a decade.

Meanwhile, the manufacturing base and the living standard of people have increased substantially due to globalization and improved economic conditions. These demand additional use of power. Moreover, many of the thermal power plants are old and some are working beyond their plant life. Substantial investment by the Government has not been made for long in this core sector creating a paradoxical situation.

According to an estimate, the country has abundant coal-reserves to last nearly 200 years. There is also vast hydroelectric potential of 150000 MW of which only 17% is now tapped. India has abundant thorium and other nuclear fuel reserves form which it can produce a reasonable portion of its need. According to the projection, nearly 10000 MW of electricity will be produced through this route by the end of the Eleventh Five-Year Plan. Nuclear power is a clean and environment friendly source of energy. No conventional pollutants of any significance are released to the environment and thereby reducing substantially the level of green house effect and acid rain.

The country is also blessed with a huge number of mighty rivers and these sources could be the promising route of generating hydro-power at a competitive price in future days. We have been utilizing this source for quite a long time but the path has not become so popular due to huge initial investment. Considering the upward increase in the cost of raw materials for conventional path of generating thermal and nuclear energy, the hydro-power would surely be an economical one within a short period of time. The 50000 MW hydro initiative launched last year has been completed and pre-feasibility reports for many schemes are now available for development in various parts of the country. The planners of this country have already initiated a Task Force on Interlinking of Rivers under the Ministry of Water Resources to identify the possible routes for diversion of surplus water resources from water rich zones to scarce areas for various uses including the option of generating hydro-power.

Besides above, a large number of potential alternative sources are available in the country from which a substantial portion of our energy demand could be met. Due to faster depletion of natural resources, namely, coal, petroleum, natural gas, etc, the importance of renewable sources has been understood by the planners. The Ministry of Non-conventional Energy Sources, MNES has been working as a nodal Ministry covering all major renewable energy sources, including biogas, biomass, solar, wind, tidal, urban and industrial wastes with a view to generate power at the available place of raw materials. Nearly 3.65 million bio-gas plants and 35.2 million improved wood stoves have been installed in rural India.

The Electricity Act, 2003 has been enacted and the provisions of this Act (except section 121) have been brought into force from June 10, 2003. To encourage private participation both in thermal and hydel-power, certain fiscal concessions are provided to attract foreign investment as well as to make the tariff cheaper to customers.

Besides the available natural resources for power generation, we have a large pool of highly skilled technical personnel who can meet the manpower requirements. India is one of the largest power markets. Both technology providers and foreign investors can be attracted by the nation.

The utmost job by the concerned professionals in this sector is to have an integrated and co-ordinated road map with a comprehensive strategy to realize the dream of "Power to All".

To achieve such a dream in a country like ours, all potential sources of generating power should be synergised with a common objective te put India into a power surplus state.

SCIENCE AND TECHNOLOGY SCENARIO

At the time of independence, there was hardly any scientific and technological infrastructure in India. Over the last four decades, an infrastructure and capability largely commensurate with meeting the national needs, has been created minimizing the country's dependence on other nations. At present, the country has a large pool of human skills, a wide acquaintance with both the basic and the applied scientific knowledge and also a huge expertise to identify the priority areas of our needs in order to draw a framework for future national development. The architecture of the modern India Pandit Jawaharlal Nehru, the First Prime Minister of India. felt the importance of judicious admixture of science and technology for the benefit of mankind. During the fifties, a large number of National Laboratories were instituted with a mission to carry out research on the then emerging areas of S&T. With the passage of time, the number of National Laboratories have increased and they have unfolded their research horizons to a larger extent based on the contemporary needs of the country. Besides the National Laboratories, public and private sector industry, non-profit institutions and academic establishments have actively been participating in the research and development. The expenditure being incurred on R&D head in the field of S&T in India is not very encouraging as compared to the developed nations. Before the onset of globalization, the Indian major industries in general were totally protected by the state and R&D activity in the sector of S&T was meager resulting in poor quality of products in the market. The opening of globalization has suddenly brought opportunities for foreign investors and leading international market players to grab the huge Indian domestic market. The sudden change has also brought a competitive edge amongst the Indian manufacturers and they have understood the new market rules for their long-term sustenance. Backed with the changed philosophical attitude of advancing the business, based on indigenous technology, the Indian industries have started spending a part of their profits in R&D and the early dividends of their investments are now showing encouraging results. The Government of India has now changed its conservative outlook and has adopted a liberal S&T Policy from 2003. The policy provides a blue print for future programmes. The policy further outlines the approach to S&T governance, optimization of existing physical and knowledge resources, development of innovative technology, systems and technologies for mitigation and management of natural hazards, generation and management of intellectual property and creation of awareness amongst general mass about the use and benefit of science and technology.

India has strong education base in the area of S&T. The major international players in the manufacturing sectors along with world notch R&D establishments feel now comfortable to start their manufacturing and research hubs in India. The confidence reposed to Indian S&T professionals by them should be considered as an opportunity. To encash this situation permanently, I appeal all professionals to rededicate themselves for the national cause and do some exemplary contributions. The canvas of Indian S&T is really broad and it is difficult to present its panaromic view. However, certain long-term mission-oriented researches, namely, space, deep-sea, smart materials, nuclear, natural disaster monitoring, etc have been undertaken by the planners with a goal to provide a strong foundation of Indian S&T and thereby command its knowledge internationally to transform its S&T community as a forerunner of the global knowledge-based society.

CONCLUSION

Considering the threats and weaknesses before the engineering profession and also assessing the country's strength and opportunities, we can do a lot towards the enrichment of our profession in particular and development of society in general. This endeavour can yield a remarkable transformation of the society provided a long-term developmental plan is mapped stressing the priority areas with active support of average people and also eliminating the conventional bureaucratic attitude of planning. Unless the basic interests of average people in the country are focussed in the planning process, the attempt of any development will not yield sufficient results for the benefit of mankind.

I strongly recommend to induct more and more scientists, engineers and technologists in all the planning processes, be it in the private or government sectors, so as to reap their benefits in future days. A proper blending between scientists, engineers, technologists and planners can usher an era of changed scenario in which the only mantra of all will be national development at the earliest focussing our traditional value of 'Unity in Diversity'. For the first time ever, all the nine members of China's elite Politburo Standing Committee, the highest tier within the Communist Party of China, are engineers.

As mentioned already, India is the second populous country in the world with highest productive youths who are the backbone of any society. Our available natural resources are abundant, human skills are considered as best in the world, polity is stable and the GNP has been increasing at the rate of 7%-8% for the last couple of years. With this backdrop, I am confident that India in near future would take a leadership role internationally as far as the development is concerned.

I appeal to all members of the Institution and also the members of the fraternity to rededicate themselves for this noble cause and try relentlessly until the goal is achieved. I know a lot of hardship will come on our way but the journey to the cherised goal should be continued with utmost vigour and sincerity. Let us be the forerunner to make our nation a promising and prosperous one with highest respect to knowledge, that is, the main driving force of a vibrant society.

As per Chanakya, before we start some work, let us ask three questions : why we are doing it, what the results might be and whether we will be successful. Once we think deeply and find satisfactory answers to these questions, we can go ahead. I know the path is tedious and responsibility is huge but, time is limited.

I, therefore, feel tempted to quote:

"Shwya Karma Adya Kurbit Purbhane Chaparanhykam
Nahi Pratikhyate Mrutyu Krutamasya Naba Krutyam".

meaning "Let us do tomorrow's work today. It is better to do afternoon's work during the forenoon. Death (time !) does not wait if our work (will !)is complete or incomplete"

Before I conclude, please permit me to quote only the closing statement of a poem with feelings expressed seven month ago by a terminally ill, tall and young girl lying in a New York Hospital:

X X X X X X X X X X X X X

"You should better slow down, do not dance so fast,
Time is short, the music will not last.
When you worry and hurry all through your day,
It is like an unopened gift, thrown away.
Life is not a race, do take it slower,
Listen to the music, before the song is over".
The beginning statement of my late reply to her was:
You are ill and I am well, our tenure is quite short,
You are tall and I am short, let us dance very fast.
You are young and I am not, life is always a duty,
Life is also a tragedy dear, life is also a beauty.
Life is truly a song darling, let us sing together,
Let us dance faster and faster, the music will last longer.
When we work and feel tired, after the end of the day,
We have friends here and there, to help us and say "Hai".

X X X X X X X X X X X X X

As I have friends everywhere, I am confident that with their active supports, it would not be difficult for me to complete the objectives mentioned in my address in addition to normal activities of this great Institution.

I wish you, your near and dear ones and the entire engineering fraternity a very Happy New Year and an Eventful 2006.

Thank you,

Dhanyabad, Namaste.

Prof (Dr) S C Naik—A Brief Profile

Prof Naik is a Chemical Engineer of national repute, a champion of professionalism, a social activist, a litterateur and a person par excellence. He obtained B Tech from the premier University of Madras and thereafter, worked for two years in industries. He did M S from University of Ottawa, Canada and Ph D from University of Wales, UK. He was a Postdoctoral Fellow at University of California (Davis) and a Visiting Staff at University of Wales, UK. He worked with internationally famous two Professors, J F Richardson and J M Smith whose several text books are still adored by every Chemical Engineer in the world.

Prof Naik worked for three decades at National Institute of Technology, NIT, Rourkela, Orissa where he was Professor and Head of Chemical Engineering and a Dean. He held several assignments and was instrumental in many innovations and developments including starting a Postgraduate Programme in Chemical Engineering and a degree programme in Ceramics Engineering, the only NIT having such a programme in the country. He inspired all his students, colleagues and peers by his outstanding performance and admirable qualities and by the lofty and exemplary standards of professionalism that he set for himself. He authored SI Unit Data Book, a chapter on Rheology, Volume-II, Plenum Publishing Corporation, innumerable review and popular articles; co-authored several papers in international and national journals and an objective type of book on "Fundamentals of Chemical Engineering". He presented papers in many national and international conferences abroad. He is a member, MISTE of Indian Society for Technical Education. He guided M Tech and Ph D students and helped in establishment of three small scale industries in Orissa, a private engineering college and Biju Patnaik University of Technology in Rourkela. He travelled widely in Asia, Europe and North America.

In 1985-86, Prof Naik was elected at the national level from Chemical Engineering Division to the Council of The Institution of Engineers (India), IEI and has been continuing since then winning six consecutive elections, each for four sessions and thus, a total of 24 sessions which is a rare achievement. He is a Fellow, FIE, a Chartered Engineer, C Eng(I) and a Professional Engineer, P Eng(I). His contribution to IEI has been always exemplary and excellent and he has held all possible positions. He has been the Chairman of eight different committees including the Committee for Advancement of Technology and Engineering, CATE and a Member of twenty other committees.

Prof Naik was instrumental in arrangement of land and completion of a modest building for Rourkela Local Centre, addition of two more Local Centres in Orissa and achievement of highest percentage of membership growth for his Division among fifteen Engineering Divisions of lEI. He has been Chairman of Rourkela Local Centre, Chairman of Chemical Engineering Division Board for ten sessions, Consulting Editor of Division Journal since seven years, co-author of a "Guide Book for Engineering Divisions and Other Technical Activities", a text book on "SOCIETY AND ENVIRONMENT"— a compulsory subject for Section A, AMIE students, published by Oxford IBH and a Vice-President of IEI. He has represented IEI several times abroad. He has been an outstanding organizer of several regional and national technical events and a founding member of many professional centres in the State. He has been deeply involved with another prestigious professional .institute, Indian Institute of Chemical Engineers, IIChE and he is its Fellow, FIIChE. He was the founder Honorary Secretary of Rourkela Regional Centre of IIChE and then, its Chairman. He helped in establishment of two more Regional Centres of IIChE in Orissa.

As a litterateur, Prof Naik stood first in All India Oriya Essay Competition, contributed several poems, articles, social novels and was the main author of a Chemical Engineering Glossary in Oriya. A witty orator par excellence, he was a moderate student leader and had all Gandhian habits and dress while he was a student. Since four decades, he is involved in Rotary Movement and in several Gandhian Institutes for community service. He has attended many Rotary Events in India and abroad and also, a Rotary International Convention in USA. His greatest weakness is that he has no ability to say easily" NO" to a noble cause. This weakness has become his greatest strength and he has become a popular figure in Rourkela, the industrial capital of Orissa. He has been associated in various capacities with many Universities, Academic, Research and Industrial Institutions and Government bodies—both at State and Central levels.

For his excellent contribution to the profession, literature and social service, Prof Naik has received many laurels. He has received nine awards at National and State levels: for best Technical Papers at National level; for best R&D work, as an Outstanding Chemical Engineer, Eminent Engineer and Eminent Teacher at State level. Prof Naik is also listed in 'Who's Who' of Indian Writers (Kendriya Sahitya Akademi). He received Citation from President, Orissa Sahitya Akademi and further, he was felicitated by Orissa Sahitya Akademi. He has received Jour Certificates of Appreciation at State, National and International levels for social service.

Shri D K Gowda
President 2006-07

Presidential Address

It is a memorable day for me to assume office of the President of this prestigious Professional Body filled with high academic and intellectual personalities. I am highly indebted for the honour bestowed on me by my colleagues and professionals. My heartfelt and affectionate greetings to all of you and I salute everybody with profound respect. On behalf of all of you, as well as on my own behalf, I congratulate the retiring President, Prof (Dr) S C Naik, for very ably stewarding the activities of the Institution during the session 2005-2006.

Our Institution is like a very big ship sailing in an ocean which has to face at times rough weather and most of the time, the Captain has the moral responsibility to ensure the safety of the inmates and safe arrival at the destination. So is my position today as the President of this Professional Body. We have today thousands of experts in this ship and each expert has a role to play. However, only combined and coordinated efforts of all shall see the ship sailing smoothly and overcoming the high seas.

I am proud to say that as all the individuals in the group are doing excellent work, my work as the Captain of this ship is thus easy.

Our country is endowed with bountiful natural resources but the planners are yet to make good effort for all-round economic development with newer technologies. We need our villages to be developed with minimum requirements, like primary education, rural health centres, water and electricity. We have appliances with tractors attached with cultivators, renovators, etc but only a few villages have these provisions. Development of good roads to reach towns/cities is still a dream. We have plenty of solar energy but that is yet to be exploited. My dear fellow engineers, we have the largest technical manpower in our Institution. This technical manpower needs to contribute its might in addressing the issues of nation building. Our country has to go for developed technology for adding pollution-free power to the present installed capacity to meet the demand of industry as well as agriculture. Our Institution needs to playa major role in fulfilling this objective.

The Institution of Engineers (India) has selected the theme as 'Challenges of Engineering for Sustainable 10% Growth and Beyond' for this Engineering Congress. Its aim is to see India as a fully developed nation by the year 2020. The task is very gigantic and challenging. If the political leaders and administrators put full confidence on engineers and technocrats, India can become economically sound with the use of latest technology and engineering devices and also with the best use of the talents of India.

I am proud to say that many foreign countries are using skills and knowledge of Indian engineers who have proved their talent in different fields of engineering. I am sure, every engineer in his specialized field can contribute sincerely with dedication for the benefit of mankind at all levels.

Every engineer should remember Sir M Visvesvaraya, the Role Model for engineers, whose vision was broad and encompassed many directions. He put his thoughts into action by establishing State Bank of Mysore for financial and commercial help to business people, primary schools for women and technical institutions for developing engineering education; His vision and dedicated work as engineer statesman laid blazing path for emulating by generations of engineers. We should follow the path laid down by Sir M Visvesvaraya — an eminent engineer, statesman and economist. As engineers of this country, we have to develop: (a) character, (b) commitment and (c) hard work culture.

We all know, we have Six Fora with specialized focus, namely:

1. Engineering Staff College of India
2. National Design and Research Forum
3. Water Management Forum
4. Rural Development Forum
5. Sustainable Development Forum
6. Safety and Quality Forum

These Fora go beyond straight jacket engineering disciplines to address specific issues for nation development in focused manner. In addition, our Institution is closely associating and interacting with a number of other sister organizations of special nature and has established bilateral relationship with twenty-four Professional Bodies in eighteen countries. I am happy that continuous progress is being made in all areas mentioned above.

Engineers create physical wealth for the nation. The engineering profession, however, needs to be regulated for it to become directionally effective. The proposed Engineers' Bill, where the Institution has provided major contributions and which aims at making the engineers accountable without over-regulating the profession, will pave the way for a more regulated environment for the engineering fraternity. Constructive cooperation with the professional bodies, liaison and follow up with the Government of India and continued efforts are needed to get the Engineers' Bill converted into an Act of Parliament at the earliest.

In the globalized world, we need brand equity for our highly competent engineers. This is sought to be achieved by the Institution by realigning the certification of Professional Engineers. The revised certification of Professional Engineers in line with international norms will not on1y give special status to such engineers, it will also make them mobile across the world due to the Institution's expected full membership of Engineers Mobility Forum. This is a big step forward for the Institution in service of the engineering profession.

The mega project of interlinking of rivers is yet another opportunity where the Institution has offered its services to the Government. This project is a challenge to prove our engineering mettle and demonstrate to the public at large the capabilities of engineers in improving lives of our countrymen.

To focus on the United Nations Millennium Development Goal, we have to aspire for continuous improvement in providing the common man with all the minimum requirements starting from primary education leading to technological advancement which will in turn bring quality life to the humanity. It is not only preaching. I mean actual action and results like what Sir M Visvesvaraya, our Engineer-Statesman achieved who worked for the betterment of humanity.

The engineers have always stood the test of time to combat all types of national disasters at the risk of their lives. We should develop and train our budding engineers in the event of natural disasters like earthquakes, floods, tsunami, etc. They must come forward to contribute in relief measures for the victims.

Quality in all our endeavours must find important place. It is my desire that we should get Quality Management System, ie, ISO 9001-2000 certification for all our Centres in India. Our State and Local Centres' Chairmen should create necessary infrastructure for obtaining ISO 9001-2000 certification for Quality Management System and sustaining it.

Ours is the first Professional Body of engineers. Founded in 1920 and incorporated by the Royal Charter in the year 1935, The Institution of Engineers (India), a multi-disciplinary nationwide organization with more than five lakh members, the first to introduce a non-formal Engineering Education Programme, having international status, bilateral relations with many organizations around the world, needs to focus on a few issues at hand:

- Worldwide acceptance of Indian engineering courses.
- Rightful place of its members in the society by providing equal opportunity to enjoy the rights and privileges of the Institution.
- Inculcate design and research abilities amongst its members.
- Dissemination of knowledge through lectures, discussions, conferences, publication of papers, periodicals/journals, etc.
- Creation of opportunities for continuous professional-development of engineers.

Our Centres and Fora are the fountain heads of our activities. All of these are headed by eminent engineers with vast experience and I ern sure that with their focused attention, the objectives, as mentioned earlier, would be met with thundering success.

We need to establish more Student Chapters, concentrate on Institutional Membership, to give prominence to the Engineers' Day celebration and improve external communication with parliamentarians, academicians, bureaucrats amongst others, so that the message of the Institution and understanding of its work improves. Importance needs to be given to Journals for publication of practice oriented papers. We also need to revitalize Stote/Local Centres which are not functioning at expected levels.

All the Council Members, Chairmen and Honorary Secretaries of State/Local Centres know that the Council Meetings, Division Board Meetings and Meetings of various Committees are to be held in different parts of the country. I would appeal to all our Council Members and Office-bearers of the State/Local Centres to come forward voluntarily for hosting these meetings in their respective Centres so that the abundance of offers make the choice a difficult proposition.

Finally, I make a fervent appeal to all the Council Members and the Chairmen of State/Local Centres and also Corporate MelJ1bersfor membership development in various categories which would strengthen The Institution of Engineers (India) as the biggest engineering force.

My heartfelt thanks to all those who opted me as the President and others who have been supporting me for decades in all my endeavours.

Shri D K Gowda—a Brief Profile

Shri D K Gowda, FIE, is a recognized civil engineer with specialization in irrigation and has served the Government of Karnataka in the Public Works Department for more than thirty-five years on assignments of construction of major and minor irrigation works, roads, buildings and bridges. He has vitally contributed for the successful completion of major irrigation projects like Bhadra and Thungabhadra in command area development in about 0.8 million acres. He has been actively associated with the Karnataka State Centre of the Institution for the last twenty years. He has served the Centre Committee as Convener of Civil Engineering Division, and also as Joint, Honorary Secretary and Honorary Secretary. He contribute his mite for the Eleventh Indian Engineering Congress and the Commonwealth Engineers' Conference hosted by the Centre. During 1998-2000, he was nominated to the Council and was again elected to the Council for the sessions, 2000-2004 and 2004-2008. He was the Vice-President of the Institution during the session 2004-2005. He is a Rotarian for the last twenty-five years serving the humanity and has extended his service liberally in the field of education as well by establishing the K D Education Society in a rural area of Karnataka. He is a Paul Harris Fellow and was the President of Rotary Club of Bangalore Peenya during the year 1988-1989. He has also attended the Rotary International Convention at Nice near Paris in the year 1995. Shri Gowda has been elected as the President of the Institution for the session 2006-2007. He will assume office at the Eighty-seventhAnnual General Meeting of the Institution to be held at Guwahati on December 24, 2006.

Shri R P Gupta
FIE

President 2007-08

Presidential Address

I am grateful to the Members of the Council of the Institution for the honour they have extended by electing me to the coveted office of the President of his august body. I accept it in all humility. I consider this as a unique instance because this will be, perhaps, the first time in recent years that a member of an emerging engineering discipline, namely, the Metallurgical and Materials Engineering, has been chosen to lead this august body. This is proof of how the Institution which fosters a federation of engineering disciplines is striving to give equal importance and weightage to all disciplines no matter whether they are developed or developing, or new and emerging. I have no doubt that our close bonds and united efforts will take us on further from strength to strength in the years to come as it has been in the past 87 years of the Institution's glorious history.

I am very well aware of the tremendous responsibilities which will rest on me in this high office in the context of the Institution's dynamic spread and keen interests and involvement in advancements at the national level as much as its much-sought for leadership in the sphere of international activities. All the same, I am most confident that I can always count upon the goodwill, wholehearted cooperation, enthusiastic support and enlightened guidance of the Members of the Council as well as the members of the engineering fraternity as a whole to help me elevate our profession and the image of the Institution even more, notwithstanding the ever increasing challenges that are swiftly overtaking all our efforts. I would very much count on the support and guidance of our illustrious Past Presidents who have added glory to this great Institution by their immense contributions to the development of engineering profession and fraternity.

I feel duty bound on this momentous occasion to convey, on behalf of all of us, our sincere regards and thanks to the outgoing President, Shri D K Gowda. A personality commanding such excellences of head and heart as Shri Gowda is difficult to find. I would, on my own behalf, like to reassure him that I shall with pleasure share his precious thoughts and strive to the utmost to maintain the high standards he has already set for furthering the frontiers of the Institution's professional and learned activities both at home and abroad.

Today we are indeed very fortunate to have amidst us our respected Chief Guest who has honoured us with his presence to bless us through our deliberations. We are immensely grateful to you Sir, for having given us this moment of happiness, sparing your precious and pressing time for our sake. We are also equally thankful to the several dignitaries, friends and well-wishers who, despite their pre-occupations, have come here which is a positive indication of the love and affection they all bear for the profession we are committed to. On behalf of the National Council and Members of the Institution I thank those who have come here from all corners of the country, for their inspiring presence. We have also with us here many distinguished visitors from overseas who have very kindly responded to our invitation. On behalf all of you, I welcome them heartily and offer our hearty greetings and very best wishes. I hope they will enjoy our hospitality, have a comfortable stay and return with pleasant memories.

The Institution of Engineers (India)

It would be worthwhile to mention in brief the aims, objectives and activities of the Institution of Engineers for the benefit of our new members as well as non-members. In order to understand the process of development/evolution of the Institution of Engineers (India), we have to take a look at the historical background.

The dedicated initiative of Sir Thomas Holland, the President of Indian Industrial Commission led to the inception of 'The Indian Society of Engineers', which was transformed into The Institution of Engineers (India), established in 1920. The Institution of Engineers (India) was inaugurated in 1921 by Lord Chelmsford, the Viceroy and Governor General of India. Sir Rajendra Nath Mookerjee was installed as the first President of this Institution. The associated members and students examinations were introduced during 1928-31 with only a few candidates. The number of candidates has increased to manifold with the passage of time and at present approximately 70 000 candidates appear in the examination. This examination is not only the oldest but also the most promising nonformal engineering examination in country and

2000-3000 young persons, qualify at the final examination every year and are widely accepted in India and abroad, as they are considered equivalent to engineers graduating from other/formal institutes and universities. This has specific social relevance as under this non-formal mode those who want to earn a qualification equivalent to BE / B.Tech. degree while in service can do so without leaving their jobs. The Institution also offers Post Graduate Programme, in non-formal mode, for practicing engineers in five disciplines. Those who clear two modules of this programme are awarded Diploma of The Institution of Engineers (India) and subsequently after passing the third module of the same course, the Master's Degree in respective engineering discipline is awarded by the Birla Institute of Technology, Ranchi, (a deemed university) according to a MoU with IEI.

His Majesty King George V granted Royal Charter in 1935 to The Institution of Engineers (India) endowing the Institution with distinctive responsibility of promoting the general advancement of engineering services and their applications in India. The main objectives of the Institution include : advancement of engineering science and its applications in India and to facilitate advance transformation of knowledge and exchange of information and ideas on those subjects. In order to realize these objectives the Institution has been playing its role at all the fronts -

publication of learned papers in all disciplines, establishment of library services in various parts of country through its 94 State / Local Centres, promotion of continuing education in a new orientation, enlarging the membership profiles through diversification of technical activities, retrieval of information and utilization of relevant technology, improvement of professional qualifications, involvement in the national policy, enhancement of technical activities in various parts of the country, dissemination of expertise in specific areas of reconstruction and highlighting the role of The Institution at the highest level.

The Institution of Engineers (India) is a multidisciplinary professional body encompassing 15 Divisions, each looking after activities of a particular engineering discipline. Each Division, besides other technical activities, holds its National Convention and National Seminar every year to disseminate engineering advances in that discipline and to facilitate wider interaction amongst its members. The deliberations at these seminars are summarised into a set of recommendations which are forwarded to the policy makers for effective implementation.

The Institution has also established six autonomous fora for meeting the challenges related with specific areas of national interest. Of these the Engineering Staff College of India (ESCI) organises various technical training courses throughout the country to upgrade the technical knowledge of practicing engineers and technologists. It conducts continued education courses to upgrade and update the technical and professional knowledge of the practicing engineers. National Design and Research Forum (NDRF) disseminates the desired information in all matters related to engineering design and research and propagates the indigenous concepts emerging from the relevant priority areas in the field of engineering. Rural Development Forum (RDF) has its prime objective of upgrading the quality of life of the rural poor by absorption of the outcome of scientific developments coupled with appropriate and low-cost technologies operable with locally available resources. Water Management Forum (WMF) offers technical expertise for conserving water resources and also implementing water management techniques, so as to ensure optimal use of water while maintaining water quality. Sustainable Development Forum (SDF) propagates the message of sustainability in engineering and related development. Safety and Quality Forum (SQF) was established with the main objectives of promoting safety and quality awareness in engineering operations.

The Institution of Engineers (India) has been playing a leading role at the international level towards shaping the noble profession of engineering to cater for the vital needs of the world of 21st century and transforming our society into knowledge based society. We have five Overseas Chapters and bilateral relationship with 24 sister professional societies of international repute in different countries across the world. IEI is a member of various international bodies including the Commonwealth Engineering Congress (CEC), World Federation of Engineering Organizations (WFEO), World Mining Congress (WMC), World Energy Council (WEC), Federation Internationale du Beton (fib), and Federation of Engineering Institutions of South and Central Asia (FEISCA).

The mobility of engineers throughout the world is gaining importance with the emergence of WTO in 1995 and the introduction of GATS. The Institution has been granted the provisional membership of the Engineers Mobility Forum (EMF), now we have to make concentrated efforts to become a Permanent Member with active co-operation and support of other professional bodies and engineers.

Role of The Institution of Engineers (India)

- The Institution is striving hard to contribute its might to help engineers and engineering organisations in meeting the challenges.
- Imparting education through AMIE exams with high standards and uncompromising quality is one such step.

- Efforts to launch Engineers Mobility Forum in the country is another lead taken by the Institution. This enables engineers from our country to become members of global teams.

- Capacity building through continuous professional development is another major initiative taken. All the Centres of the Institution have been organizing various technical activities to promote this avowed objective.

- Imparting professional training is another significant activity taken up. Through one of its forum, Engineering Staff College of India (ESCI), thousands of engineers are being trained every year, enabling them enhance their knowledge levels.

- The Institution is encouraging young engineers through research grants to promote R&D activities.

- Our publications are recognized for their high standard and contributing to technological developments in all branches of engineering.

There are several challenges before us.

In the area of non-formal engineering education certain schemes for the students are the need of the hour. We have already started providing quality course materials and teaching notes to our students to help them prepare for their examinations. Since many of our Council Members are academicians and learned professors, their active participation in the process of preparing study materials and upgradation of the syllabus for Section B of AMIE examinations will be very much appreciated. It is also desirable that our State and Local Centres open AMIE guidance classes to enable our students to face the examinations better and bring improvement in their performance.

The absence of regulation of engineering profession in India has a tremendous repercussion on growth and sustainability of development. The Institution after discussion with various professional institutions, government authorities etc. has prepared a Draft Bill which has been presented to the Ministry of Human Resource Development for finalisation and acceptance. The Draft Bill provides for registration of engineers after acquiring graduate level qualification and renewal of registration at reasonable periodicity after assessment of continued involvement in the profession and achievement of minimum continuous professional development. IEI should gear up to provide means and facilities for the registered engineers in the process of continuous professional development by organising high quality technical activities on issues of current interest. I look forward to our State and Local Centres to organize more number of seminars, lecture meetings, round table discussions and workshops to augment this process.

To ensure mobility of our engineers and acceptance of their competence and quality outside India, IEI is going ahead in association of other professional institutions like IETE, ImarE, Aeronautical Society of India etc with full speed in implementing the system of professional engineers certification. Towards this end, as already stated earlier, IEI has been awarded the provisional membership of EMF and we are trying our best to acquire the full membership at the earliest.

IEI has been for a long time advising Central and State Governments on various policy making initiatives on projects and issues of national interest involving engineering problems. In order to boost the image of the Institution before the Government and the policy makers, it is high time that we set up a mechanism for continuous interaction with the Government at the highest/secretarial level by direct participation or by presentation before the various empowered committees. Simultaneously, in order to create positive feeling and the response from the public on various welfare initiatives of the Government, IEI has to take up the issues and organize technical activities of current interest.

IEI is looking forward to participate in many more programmes in making our engineers develop themselves to enter the arena of globalisation and prove themselves to be the front players. In this era of multinational competition, let us wish our engineers will prove that we are no less than others in the field of engineering and technology.

We are going to declare 2008 as the Membership Growth Year during which a number of progressive steps are proposed to be taken for growth of membership of the IEI as well as for betterment of quality of service to the members and society at large.

I invite you all to join, assist and support us in our endeavours to deliver goods for upliftment of standard of life of the common man and to contribute our mite towards the economic development of our country for making it a developed nation by 2020 as envisaged by the erstwhile President of India.

I express my gratitude for your August presence here and sincere thanks for giving me a patient hearing.

Shri R P Gupta —— a Brief Profile

Shri R P Gupta, FIE, a graduate in metallurgical engineering, joined National Engineering Industries (National Bearing Co Ltd) in 1964 and served for 36 years occupying key technical and managerial positions. His quest for knowledge led him to a postgraduate course in Business Management in the year 1980. He has wide experience in planning, developing, installing and controlling metallurgical units engaged in mass metallurgical production, heat treatment and quality control in engineering industries and especially in bearing industries. A Qualified Lead Assessor through Nigel Bauer and Associates, UK, he was responsible for implementation of the international quality systems like ISO-9001, ISO-14000, QS 9000 and Quality-circles. Shri Gupta has been associated with the Institution for more than three decades. He was Honorary Secretary and then Chairman of the Rajasthan State Centre. He has been a Member of the IEI Council since 1995 and served in various committees including Committee for Advancement of Technology and Engineering (CATE), Bye-Laws Committee (BYC), Land and Building Committee (LBC), Service Rule and Headquarters Management Committee (SHMC), Finance Committee (FC). Presently, Shri Gupta is the Chairman of the Metallurgical and Materials Engineering Division Board. He also served the Institution as Vice President during the Session 2003-04. He has been instrumental in organising a number of technical activities, including National Conventions, All India Seminars, Indian Engineering Congress, etc. On the personal front, Shri Gupta finds time to catch up with creative and social responsibilities. An active Rotarian, he was elected President of Rotary Club Mansarovar, Jaipur. He is also associated with several social and religious NGOs. Presently, he is Executive Director, Bansal Classes, Jaipur.

Vice Admiral K O Thakare

AVSM, NM, IN (Retd)

President 2008-09

Presidential Address

I consider it a proud privilege to be amidst this galaxy of distinguished dignitaries, leaders of engineering profession, doyens of academic world, R&D and industry who have assembled here for inauguration of the Twenty-third Indian Engineering Congress, I express my profound thanks to the Honorable Members of the Council of The Institution of Engineers (India) who have accorded me this honour to preside over The Institution of Engineers (India), a unique and fine professional body. The Institution has indeed come a long way over the past 88 years since its inception in 1920, rendering yeoman service to the nation, the engineering profession and personnel as also to the industry. Today, we are standing at a critical juncture wherein global competition and global recession have reinforced the mantra 'Perform or Perish'. At this juncture, it is our onerous responsibility to negotiate through the turbulent times, surmount all hurdles and difficulties and take this Institution to greater heights. I am acutely aware of the fact that it would not be possible for a single person to accomplish this herculean task. However, at the same time I am confident that with the support and cooperation of my learned colleagues in the Council, all members and the staff of the IEI we would be able to steer this fine Institution of ours to greater success and restore its prominent status. I acknowledge the sterling contributions by my illustrious predecessors, as also the outgoing President Er R P Gupta, in furthering the laudable objectives of the IEI.

The success of this unique Institution of ours, cannot be measured in terms of turnover or productivity, but can be seen in terms of excellent service being provided to its around 600,000 members and to the engineering fraternity of the country, by providing them a platform to enhance their skills and knowledge base through mutual interaction and affording an opportunity to share their thoughts with the stalwarts in the field of engineering. It is widely acknowledged that engineers are the backbone of the society and have a great responsibility towards development of the nation as also the mankind. Our national dream of touching double digit GDP growth would require major contribution by industry and the engineers manning them. Our efforts to transform of our nation from an agriculture-based economy into an industry-based economy have been powered by the vast pool of engineers available in our country. The comfortable position that our country enjoys now with respect to foreign exchange reserves are due the boom in the IT sector and other industries which are sustained by the engineers of our country. Keeping the above in mind, the Institution has been providing engineers, as well as the aspiring engineers, a platform for gainful professional interaction and development so as to contribute in national growth. Towards this end, the Institution has been organizing various activities like seminars, symposium, lecture meetings and National Conventions pertaining to 15 Engineering Divisions throughout the country, where professionals in the field of engineering get an opportunity to discuss, deliberate and exchange views, share experience and disseminate knowledge. The Indian Engineering Congress is the apex activity of the Institution holding a special status amongst the engineering fraternity. At the Indian Engineering Congress, we have a gathering of professionals and engineers from all the disciplines of engineering. The vibrant discussions and deliberations that will take place in these three days will enlighten and enrichen us as also make us conscious of the increased responsibility of the engineers in protecting the Mother Earth and make it a better place for future generations.

The dawn of civilization saw man's quest to engineer his world fuelled by primal needs of survival. Neanderthal man's ability to create and sustain a fire at will and the invention of the wheel were perhaps the first engineering accomplishments of our ancestors. The evolution of man and indeed his rise to top of the hierarchy of species that inherit the earth has since been inextricably linked to his ability to apply thought and imagination through innovation and invention. It is no wonder that Homo Sapiens — 'The Thinking Man' has been re-designated by modern scientists as *Homo Sapiens Sapiens* — 'The Thinking Man who Thinks'!

From the time that man invented the wheel, lever and other devices that provided mechanical advantage to augment his sinews, to the mastery that the gained in the construction of tools and weapons, first from stone and later from metal; from building the first primitive wheel and axle manually pulled vehicle to harnessing the power of animals thereon to today's advanced vehicles and craft; from designing and innovating the primitive plough to developing means to draw water from deep wells; the historical evolution of man's inventions that established the foundations of engineering is a personification of that fact that it was engineering that has been the engine of man's evolution. Every invention of man that we sometimes now take for granted has at one time been considered a marvel of engineering and a stroke of genius. An example of this lies in a study in 1904 of the steam turbine becoming a successor to the reciprocating engine. Admiral George W Melville and Mr John H McAlpine, consulting engineers, reported: 'If one could devise a means of reconciling, in a practical manner, the necessary high speed of revolution of the turbine with the comparatively low rate of revolution required by an efficient propeller, the problem would be solved, and the turbine would practically wipe out the reciprocating engine for propulsion of ships. The solution of this problem would be a stroke of genius.' It was only in 1910 that Sir Charles Parsons, the inventor of the steam turbine, applied the helical gear to a large scale steam turbine installation. So a reduction gear that we engineers today sometimes take for granted was at one time considered to be an invention that was a stroke of genius. So it is that perhaps the epiphany of Archimedes' 'Eureka' must indeed apply equally to every feat of engineering.

The journey from the era of the wheel to the ultra modem age of the computer has been one that has frequently been lit up by stellar achievements of engineering: Achievements that enabled man to venture into outer space, harness the energy of the atom, shrink the world into a global village and break barriers of science that was once considered fiction. What perhaps remains unconquered in reality is the dimension of time.

In the present context of the modem day catalyzed by globalization and open economy, never-before-available vistas of high volume trade, international agreements, technology transfer and entirely different paradigms for economic and geo-political co-operation between the nations of the world have been unlocked. It is into this slipstream of geo-dynamics that developing nations such as India have ventured into with the full knowledge that this is a revolution that should not be missed. What perhaps is more startling is the synchronicity with which the information age has heralded its arrival hand-in-hand with the phenomenon of globalization. The engine that has been driving economic growth of our nation and the rapid realization of our aspirations to be a global power of reckoning has been fuelled by this duality of power. It is in the face of this dynamic situation that the role of engineer needs to be redefined. The technology areas that need to be mastered are multifarious and challenging. The engineer of today has an exhilarating future ahead of him provided he bravely harnesses the power of the technology of today and intuitively envisions the challenges of tomorrow. The future will happen whether we like it or not, all that can be done is to be prepared for it.

When one focuses on the multitude of new subject areas it emerges that cardinal among them is the influence that IT enabled services and telecommunication have brought to bear on every facet of the changing face of the mariner's world. Automation and human factor engineering are providing elegant solutions to improving efficiency, availability and reliability of machinery and systems. Modem communication and navigation systems, governed by satellite networks and ultra-fast communication gateways, have brought about greater awareness and clarity and have revolutionized the manner in which businesses work. Increased awareness facilitated by almost real time video, audio and data availability has made speedy, accurate and comprehensive decision making a reality. However, the boon does not come without a bane. Security of information networks and dependence on third party satellite networks are questions that need to be carefully addressed and factored into the scheme of things.

Advances in materials, computational power, software development, manufacturing processes and techniques have revolutionized design and have opened vistas of development hitherto unavailable to mankind. Modern 3D design, validation and visualization tools have reduced design effort and enhanced accuracies. Computational fluid dynamics, finite element methods and other refined mathematical modelling and simulation techniques, coupled with the enhanced number crunching and graphics capabilities of the modem computer, have rendered hitherto cumbersome tasks of design relatively uncomplicated initiatives such as those of the Project Management Institute's 'Book of Knowledge' (PMBOK) have lent structure and finesse to project planning and control using tools such as Primavera. Advanced CNC machines used in conjunction with software optimization tools has changed the very paradigm of manufacturing industry and has drastically reduced build periods and cost.

Adroit endeavors in the field applied of 'Mechatronics' have resulted in a modem generation of digital instrumentation and control systems that handle non-linear processes with finesse and speed. Microprocessor and PLC based control systems have become the order of the day. Traditional engine control systems are being rapidly replaced by full authority digital electronic controls — FADEC. Such control systems are far superior in addressing non-linear transient response requirement of today's advanced prime movers and power generation systems.

Yet another important consideration in modem engineering is the need for environmental safeties. Considerable reductions of emissions and waste heat recovery have been achieved in modem engines. Use of ozone friendly refrigerants such as 134A in place of freon has also been mandatorily implemented in keeping with the Kyoto Protocol. Drop-in kits for currently operational freon based plants are also gaining currency. The use of MARPOL compliant sewage treatment plants and oily water separators will go a long way in protecting the delicate biodiversity and ecological balance of our oceans and coastlines. Statutory provisions for water management ashore have also greatly aided the environmental cause. It is essential that as responsible engineers we continue to respect the planet and leave behind a legacy that future generations would be proud to follow.

In the face of rapid convergence of such a multitude of technologies it is essential and indeed inescapable that training keeps pace. The design of curricula, courses and training material should proactively mutate to meet the needs of advancing technology and statutory requirements. This is an all important cog in the train and will form the basis of how successfully this technology convergence and change are managed.

It is but obvious that the spin-offs of this convergence of technology is bound to be dispersed across a wide spectrum of industrial beneficiaries. Almost every conceivable industry will share the bounty of engineering progress. It is against the backdrop of this amazing turn of events that the relevance of the role of the modem engineer, particularly in ensuing sustainable and eco-friendly development, gains significance. It is indeed an appropriate theme for technocrats, mariners, engineers and policy makers to deliberate upon so as to generate a new vision for the global technical fraternity at large and the engineer in particular. This is the vision that will empower and enable the engineer of the future to continue to design, invent, exploit and maintain modem platforms, systems and equipment with the elan and professionalism that have been his hallmark. This is the vision that I leave before all of you to mull over, debate, analyze and discuss.

This brings me to sustainable development. From the time immemorial, man has been dependent on nature for his sustenance, right from the time when he used to collect wood from jungles to cook and build shelter. With passing of time as mankind progressed and became more and more civilized, the demand for natural resources increased rapidly. With this onward march of civilization, population ballooned and requirements increased manifold placing a great strain on available resources necessitating development of newer and more efficient methods for utilization natural resources. Down the line, the Industrial Revolution and the two world wars sowed the seeds of global competitiveness. This resulted in over-exploitation of the nature, putting pressure on the environment and threatening ecological balance. Mankind has been utilizing its power of knowledge and technology for upliftment of the society. We have seen through the ages how economic and industrial prosperity have benefitted the mankind, life threatening diseases defeated, advanced agricultural techniques resulted in providing food security to the developing countries, improved town planning, habitat and sanitary system resulted in increased comfort in the lifestyle of the society. Benefits from advancement in communication technology need not be explained in details as its effects are being experienced by us in all walks of life.

But on the other hand, we have also seen the disastrous effect when things went wrong, the greatly damaging oil sleeks, wiping out marine species and killing rare birds, the Chernobyl disaster resulting in long term damage to human life. And now we have the global warming and green house effects. We hear about ozone holes, the melting of ice in Antarctic and Arctic regions, deforestation and depletion of fossil fuel.

Unfortunately today, human beings and natural environment seem to be on a collision course. Human activities have been resulting in serious and often irreversible damage to the environment. Our audacious and misplaced presumption that resources are free and inexhaustible and that the nature has infinite assimilation capacity has brought us to this critical juncture. If not checked and reversed urgently, many of our current practices put at serious risk the future of mankind and that of plant and animal kingdoms: This may degrade the living world to such an extent that nature would be unable to sustain life in the manner that we know. All of us need to be aware that it is not just industrial enterprise, but the aggregate of all human activities — the all individual and collective daily activities and decisions — that are changing the earth irreversibly.

Our country is galloping ahead with pride on the path of development to become one of the frontline nations in the world with rapid urbanization, building industries and constructing multi-lane expressways and super expressways. However, we engineers need to be conscious of the role we need to play in keeping this world beautiful and healthy. The role of the engineers is not only to develop and use environment-friendly technologies that are sustainable in regard to environment, but also to create public awareness about the fact that we need to create a life that allows all present and future human beings to be healthy, have their basic needs met, have fair and equitable access to the earth's resources, have a decent quality of life and preserve the biologically diverse ecosystems vital for our survival.

It is important that sustainability is ensured in all areas. Both social sustainability and economic sustainability are equally important. Social sustainability aims at equitable distribution of resources to enhance quality of life of the society as a whole. Benefits of development need to percolate to the lowest strata of the society and not limited to small privileged sections. I think that we have miles to go before the dream of prosperity for all is achieved.

Economic sustainability aims at preventing erosion of capital. Efficient use of resources using improved technology will result in reduced energy consumption as well as raw material consumption.

Social and economic sustainability will help us in preserving the delicate balance between development and environment to ensure long term sustainability. Therefore, the theme of this Twenty-third Indian Engineering Congress has been aptly chosen as 'Environment and Ecological Challenges: Role of Engineers'. I am sure that the honorable delegates, my learned friends and the dignitaries present here for the occasion, apply themselves in developing and propagating technologies to conserve the environment, use renewable sources of energy and raw material, reduction in waste generation and control of emissions to reduce the impact on human health.

I consider it important to highlight a vital aspect. In recent times, we have seen the tremendous progress in fields of IT and service sector. No doubt that they have played a major role in our onward march, however, we need to remember that core sectors and engineering disciplines and research cannot be ignored. Neglect of basic and core areas as also fundamental tenets of prudence and thrift could make us vulnerable to difficulties being faced by many world economies.

Role of the Institution

The Institution, along with the SIX autonomous fora, is constantly working in this direction. The Engineering Staff College of India (ESCI) organises various technical training courses for practicing engineers and technologists on emerging areas. National Design and Research Forum (NDRF) disseminates information in all matters related to engineering design and research and propagates the indigenous concepts emerging from the relevant priority areas in the field of engineering. Rural Development Forum (RDF) has its prime objective of upgrading the quality of life of the rural poor by absorption of the outcome of scientific developments coupled with appropriate and low-cost technologies operable with locally available resources. Water Management Forum (WMF) offers technical expertise for conserving water resources and also implementing water management techniques, so as to ensure optimal use of water while maintaining water quality. Sustainable Development Forum (SDF) propagates the message of sustainability in engineering and related development. Safety and Quality Forum (SQF) was established with the main objectives of promoting safety and quality awareness in engineering operations.

The Institution of Engineers (India) has also been playing a leading role at the national and international level towards educating and creating awareness in society through five Overseas Chapters. IEI being member of various professional bodies is also contributing to the betterment of the world society as a whole.

I am sure that during next three days of deliberations and discussions by and amongst the congregation of renowned engineers and technologists present here, will generate ideas and throw more light on scope and opportunities for engineers in making this world a safer, more beautiful and cleaner planet to live in.

While concluding I highlight some key action areas for the IEI in the future: -

- Ensuring prominent status of the Institution.
- Contributing in the national efforts of sustainable development whilst ensuring protection of environment and ecology.
- Fostering professional interaction and growth of engineering fraternity with particular emphasis on student members.
- Holding our own in the competitive era and ensuring viability through appropriate organizational measures.
- Foster and facilitate research and interactions In basic as also cutting edge technologies.

Jai Hind and thank you.

Vice Admiral K O Thakare—a Brief Profile

Admiral K O Thakare, NM, was commissioned as a Marine Engineer Officer in the Indian Navy in 1979 and has been serving the nation with distinction for nearly thirty years.

During his service, he has discharged diverse responsibilities of professional assignments, planning, administration and training and high level management. He underwent training at various institutions with distinction and is alumnus of Sainik School, Satara; National Defence Academy, Naval College of Engineering, at INS Shivaji; Defence Services Staff College, Wellington; and College of Defence Management, Secunderabad. He has specialised in Submarine Engineering and Operations, SSK Submarines, Defence and Material Management.

Admiral Thakare has served afloat on board various frontline ships and submarines, commissioned SSK Submarine in Germany and was trial and Commissioning Engineer Officer of the first indigenously built submarine. He served at the prestigious Defence Services Staff College, Wellington, as a directing Staff and has recently commanded INS Shivaji, the premier technical training establishment of the Navy. He has handled a number of important and mega projects, such as Mid-life repairs and modernisation of a frontline frigate, Mid-life refurbishment and complete modernisation of frontline submarines, Construction of SSK and Scorpene submarines at the Mazagon Dock and Life extension and refurbishment of the aircraft carrier. Admiral Thakare is presently the Director General of the Scorpene Submarine Construction Project of the Indian Navy.

Admiral Thakare has been associated with The Institution of Engineers (India) since early 80s in various capacities. Being the Chairman of the Marine Engineering Division Board of the Institution, he has been actively involved in organising Seminars, Conventions and other technical activities pertaining to marine engineering; membership growth of the Division; improving the quality of the Journal etc. He was awarded the prestigious 'Nausena Medal' by the President of India in 2006 for his outstanding contributions and devotion to duty.

Shri Madan Lal

President 2009-10

Presidential Address

I express profound sense of gratitude to my esteemed colleagues in the Council of The Institution of Engineers (India) for electing me to the exalted office of its President in the meeting held on September 11, 2009 in the Historic city of Udaipur every particle of which is still vibrant with the stories of patriotism, bravery and sacrifices of the great Maharana Pratap. This in itself has profusely instilled in me, a stimulating sense of devoted, sincere and selfless working for the Institution.

2. I am sincerely aware and deeply conscious of the great responsibilities which go with this high office and will make all endeavours, to the best of my capability, to keep up the standards set by the eminent and illustrious personalities who have embellished and adorned it in the past. With the vast reservoir of talent, deep knowledge and wide experience available, with our Council Colleagues in particular and with the Corporate Members in general, from all walks of Engineering Science and modern technology, I am sure it would be possible to ensure further growth with consolidation of this great Institution. As an humble and devotedly sincere worker of this organisation since October, 1968, I stand, in all humility, before this august assembly of galaxy of learned engineers, scientists, scholars, management experts and elite class of people including our friends from the fourth estate, to accept and enter upon the office of the President of this Institution. I seek your blessings and good wishes to do the very best.

3. This House will be glad to know that only about three months back, on September 13, 2009, The Institution of Engineers (India) has entered into the 90th year of its existence as a pre-

eminent multidisciplinary professional body of engineers standing as a sturdy limb of body technology. It is about to complete Nine (9) decades of its glorious and inspired service to India with its undiminished romance and courtship with Engineering Science and Technology. Its activities for advancement and nourishment of technology and engineering are well pronounced. It has an avowed objective of promoting and advancing the art, science and business of Engineering in India.

The Incorporation of the IEI with grant of Royal Charter in 1935 by the then Govt. of India, at the hands of the King George V has conferred certain rights and privileges to it and its members.

4. A dilemma, the engineers are cruelly faced with, needs to be clearly and emphatically spelt out. We are expected to deliver the goods. Society expects us to execute the developmental programmes without any fuss and flurry. What, however, we find to our dismay that the ultimate authority does not lie with us. The decision making processes are repugnant and incompatible to us. While we are accountable for our lapses or omissions or commissions, the privilege of exercising authority lies elsewhere. This dichotomy will not do. We have to be made arbiters of our own destiny. No external or extraneous factor should come in the way of living up to our obligations. And with doing away with the antiquated system we can extend, with innate conviction, a hearty assurance to those who are responsible for the management of the country that the responsibilities given to us would be discharged commendably well.

5. It may be relevant to recall that The Institution of Engineers (India) was established in 1920 on the recommendations of the Industrial Commission constituted by the then British Govt. of India under the chairmanship of Sir Thomas Holland, Commerce Member of the Govt. of India. This Institution, therefore, had and has to have a lot to do with the development of commerce and Industry. It has to essentially co-exist in co-ordination and inter-connectivity with the Industry. It is, therefore, only natural that a good number of members in our Council, the apex executive body of the Institution, hail from Commerce and Industry. The inter-action with the Industry has grown stronger with the establishment of the Safety & Quality Forum (SQF) of the Institution a little more than six years ago, with its headquarters at New Delhi. SQF's Safety Awards given annually during its Safety Convention, to the Industries based on their competitive performance and record judged by a Jury of very eminent and competent Engineers and technologists, have become a very prestigious and much sought after event. It is awarded to the Industries having excellent record of zero-tolerance safety performance measured on very rigorous parameters set with very high standards and norms according to Demming's principle of Awards. This year more than forty reputed Industrial units of the country bagged this award. Senior Executives of more than seventy industries participated in the convention. This is a measure of our growing inter-connectivity with and visibility in the Industrial world.

6. The United Nations' 2009 Human Development Report which was released a few weeks ago shows that India ranks 134th amidst the list of 182 nations of the World in respect of development of standard of living. It was at 128th position in 2007 and 2008. There has been a slide down and we rank lower than SriLanka (102), Bhutan (132) and China (92). We may derive some solace from the information that some of our neighbours rank lower than us viz., Pakistan (141), Nepal (144) and Bangladesh (146). This is a very dismal and disappointing situation where we are standing even after a period of more than six decades have elapsed from the date we got independence and declared ourselves as a socialist Republican Sovereign State. India, therefore, has to do a lot more for making up from the position it is placed in.

07.01 Power is universally acknowledged as critically important infrastructure of economic development. Power Sector is the driver of growth. India has deprecatable distinction to have an inadequately developed infrastructure in this regard.

About two billion population of the World is reported to have no access to commercial energy. In India this figure is of the order 360 millions.

07.02 The present installed capacity for power generation in India is 1,52,148 MW (August, 2009) which is miserably inadequate to meet the power requirement of the Country. The Nation as a whole, is facing an energy shortage of 12% to 14% and peak load power shortage of about 16%. This is likely to have a worsening trend. This shortage is costing us very heavily. According to a recent editorial of the Times of India, the direct loss on this account has been assessed to 43,205 crores of rupees during the last financial year 2008-09. This has posited the 'opportunity cost' of the power shortage during the same financial year to a hopping sum of 2,89,000 crores of rupees or a 6% loss in GDP. The country may not be in a position to tolerate this situation for long.

07.03 Keeping pace with the Nation's power requirement, we are led to believe, if we go by our past experience, can never be accomplished. Power Sector has been apparently rendered helpless. It happens to continue to remain the most crisis-ridden among all the infrastructure segments of the country.

07.04 In none of the five-year plans we have been able to achieve the targeted capacity addition. On the contrary, heavy short falls in the planned power capacity additions have become “the hallmark trend in the power sector”.

07.05 Only about 50% of the targeted capacity addition could be achieved during the 9th (1997-2002) and 10th (2002-2007) plans. In the 10th Plan the addition was 20,950 MW only against the planned target of 41,110 MW. In the current 11th Plan (2007-12), we appear to be destined to meet the same fate as, against the targeted plan of 78,577 MW during course of more than half the plan period which has already passed by, we are still hovering around 30% of the aimed addition.

07.06 In view of the limited known stock of fossil fuel, however large it might appear to be, we have no alternative but to go in for the Hydroelectric Power Projects the assessed potential whereof is of the order of 1,50,000 MW. Out of this, according to a report of the Central Electricity Authority (CEA), 1,07,000 MW worth projects stand identified. Only about 30% of this have so far been harnessed.

07.07 It is learnt that the Central Electricity Authority has prepared a vision paper 2025-26 for development of Hydro-power in the country. India ranks 5th in the world with regard to Hydro-power potential with 600 billion kWH energy annually equivalent to 1,50,000 MW installed capacity.

16,553 MW of additional Hydel Power is planned from Large Hydro Power Projects in the current 11th Plan (2007-12) which is very unlikely to materialise as pointed out and discussed earlier. Something very urgent has to be done on war-footing to meet even this small target.

07.08 The reserve of fossil fuel we possess is not going to diminish, decay or vanish even if left unutilised. That is going to remain in reserve. But the water power potential perennially available is going a waste if not harnessed. The horrible colossal loss the nation is incurring every day, by allowing the huge water power potential to flow into the ocean without being tapped on the long stretched path of all the rivers, for the benefit of mankind, can be well imagined. It works out roughly to 168 crores units of electricity per day even at 50% availability, utilization and efficiency. Posterity may not forgive our masters for this callous neglect. The managers of the country may have to be accountable for it.

07.09 Proper answer and solution to the power shortage we are faced with, lies in adopting new and renewable sources of electricity generation and large hydel power stations. Yes, investment in per MW installation cost of a Hydel Power Project is higher at around Rs. 6.0 crores compared to about 4.5 crores of a Thermal Power Project. But the advantages are manifold ; No recurring cost on the fuel input, controlled and regulated irrigation development of the remote areas, clean power and no carbon emission.

07.10 The potential of new and renewable electrical power like wind, biomass, SHP, nuclear, Solar and Hydrogen is almost infinite. India has the distinction of being the only country which has an exclusive ministry dedicated to development, promotion, and utilization of new and renewable energy sources. Fortunately we have now a very experienced and seasoned person to head this ministry, Hon'ble Shri Farooq Abdullah. After taking over the charge of his ministry, he emphasized, at a conference, the need for new and renewable energy development to meet the energy requirements in future. Having realized the urgency of doing so we do not know what is holding our masters from making expeditious and urgent use of the abundant potential of solar, wind, hydro and hydrogen, etc. that our country is bestowed with. You need to allocate and earmark funds for huge and numerous projects to come up. Things cannot move with fast pace with scant piece-meal investments and allocations which the government makes and sanctions.

There have been only sporadic display of political will needed to push through the reforms and National Electricity Policy.

07.11 The private investors coming in the Power Sector and even the public Sector proposals and Projects have been suffering big time loss and cost escalations and are held hostage to centre-state disagreements and requirements of inter-departmental clearances, approval and concurrence. In many of the cases, the time consumed in meeting such formalities happen to be more than the actual construction and commissioning of the projects. Various departments involved in the process behave as if they are under the operational control of some alien governments. There is immediate need to simplify these procedures to minimize such agonizing and painful waiting periods by constituting a single, empowered nodal agency to provide a go-ahead signal and required clearances for all developmental projects within a reasonably short time-frame of less than a hundred days. The Nation can not afford the luxury of casual and leisurely approach on this account.

07.12 The potential of small Hydroelectric Power Projects (SHP, 100 kW to 25000 kW) is about 15,000 MW for which 4861 prospective sites with an aggregate capacity of 12841 MW stand already identified. These need to be harnessed for the benefit of rural areas; for electrifying cluster of villages in close co-ordination with the power utilities of the area. Almost all State Governments have constituted specific Governmental Agencies / Enterprises for this. Yet, only a little over 700 such SHP Projects have been commissioned with an installed capacity of about 2100 MW (March 2009) only.

A number of Mini/Micro Hydro Projects have been set up in remote and isolated areas mainly in the Himalayan Region. A number of tea-gardens have also set up such micro hydro sets to meet their captive requirement of power.

07.13 Water wheels, traditional use in Himalayan Region for rice hulling, milling grains and other mechanical applications are gainfully utilized making use of locational gift of nature. It is estimated that there are more than one and a half lac of potential water mill sites only in the Himalayan Regions of India. New and improved designs of water mills have been developed for mechanical application as well as for electricity generation of 3 to 5 kW.

07.14 Unfortunately, the manufacturing capacity available in our country for entire range of Mini-Micro and SHP equipments and accessories is very limited. There are only about fifteen manufacturers with limited capacity. The Government of India and the State Governments may do well to encourage and motivate the existing manufacturers in enhanced-capacity-building and also the new entrepreneurs to come forward to meet the increasing requirements.

07.15 Most of the Himalayan Rivers flowing into Uttar Pradesh and Bihar have their origin in our neighbouring Country, Nepal. A huge multi-stage Hydro-Power potential is lying there in the path of each river. With proper bilateral discussions at appropriate levels with Nepal

Government, a blue print of Hydel Power Stations could be worked out. According to an analysis made by knowledgeable technologists, Nepal can convent itself into a water power dollar country just like gulf Nations which are affluent Petro-dollar countries. Nepal could allow hydel power stations to be constructed with arrangements for power to be transmitted to the neighbouring countries, particularly to India after having some royalty on each unit generated and sent out. These projects could be multi-pronged projects providing power and irrigation to Nepal and abundant power and flood control to India. Nepal could become affluent with all round development and India could meet its power requirements without depleting its fossil fuel reserve for quite some time to come.

8. The Institution of Engineers (India) has been playing a frontal advisory role in the matter of power; its generation, transmission and utilization and on new and renewable energy sources through its national and international seminars / symposia / workshops. In January this year a National Seminar on “Energy Security through New and Renewable Sources of Energy” was organized at Raipur, Chhatisgarh which was inaugurated by the then Hon'ble Union Minister for New and Renewable Energy. The Hon'ble Chief Minister of Chhattisgarh addressed the valedictory Session. Yet another All India Seminar organized at Hyderabad in last July deliberated on Smart Power Grid with participation by leading learned and eminent personalities from Academy, Research and Power Industry including the Power Secretary of the Government of India. Two more such All India and National Seminars have taken place last month; one at Jabalpur (MP) and the other at Jaipur (Rajasthan) on Power Sector Reforms and assessing and enhancing manufacturing capacity of the power equipments, materials and accessories to match with the future expansion programmmes. The recommendations made by us have been making pronounced impact in all aspects of Engineering in shaping the policies as well as implementation and execution.

09.01 The quest for safe, secure and sustainable energy poses one of the most critical challenges of our age on account of grave concern for the enormous adverse effect of climate change. The basic fact of climate change can be specified as,

(i) Fossil fuel burning for any and all purposes causes carbon dioxide concentrations to rise,

(ii) Carbon dioxide is a greenhouse gas (GHG)

(iii) Increasing the greenhouse gas (GHG) increases average global temperature and has many other adverse effects.

09.02 Article 2 of the United Nations Frame-work Convention on Climate Change (UNFCCC) asserts the objective of achieving “stabilization of greenhouse gas (GHG) concentrations in the atmosphere at a low enough level to prevent dangerous anthropogenic interference with the climate system”.

09.03 The whole world has been very seriously concerned of the consequences of the greenhouse gas effect and, therefore, almost all the countries agreed and pledged to a Protocol, in a conference held in Kyoto, Japan in 1997, whereby the developed and rich nations also promised to make effective cut in GHG emissions. Even the quantum of reductions was defined and specified. Unfortunately, USA, even though fully agreeing to and endorsing the said protocol, did not formally sign it.

09.04 Under the banner of United Nations again in 2001, 186 countries met in Germany (Bonn) where the Kyoto Protocol was given final shape and it was decided that carbon emission shall be reduced by 5% below its 1990 level and the conclave fixed the period of its implementation from 2008 to 2012. This time the American delegation also signed it. However, later on, the US Senate declined to approve it on the spacious ground that the provision would adversely affect its growth rate. Subsequently, in 2001 the then US President made a formal announcement of its withdrawal from the Kyoto Protocol.

09.05 Again a conference took place in Indonesia at Bali in 2007, in which 190 nations participated. By then IPCC's 4th Action Taken Report (ATR) had been received which stroke a alarm bell that GHG in the atmosphere was going to reach a dangerous level. It fore-warned about the disastrous effects of climate change. The Report spelt out that, instead of decreasing, GHG emission had increased by 11% from the level of 1992, the year when the UNFCCC was signed. Bali convention was scheduled to decide target for GHG reduction for the post Kyoto Protocol period (beginning 2013). But nothing substantial did happen there. All attempts to get a stamp of approval on the recommendations of IPCC for reduction of GHG emission could not materialize on account of attitude of the powers that be.

09.06 As is well known, amidst the atmosphere of such stalemate, the representatives of the governments of the countries world wide are meeting at Copenhagen during the period while we are sitting here. The G77 countries, including India and China, met only about two months back at Bangkok on Climate negotiations. The talks on implementation of Kyoto Protocol remains stalled as the Governments of industrialised and advanced countries try to push negotiations towards first deciding on over-arching long term 2050 global goal for the entire world instead of 2012 and 2020 targets as envisaged and decided. Indian negotiating delegation has rightly described it as an attempt to reap "higher economic advantage in taking a lower moral ground" on part of the developed countries.

09.07 The Kyoto Protocol converts the principles of "Common but differentiated responsibilities" from mother UN Convention into quantified emission reduction targets for industrialized countries. Any shift from that from any quarter has to be pronounced loudly as totally unacceptable. The US has been always demanding a new "instrument" under the treaty or a re-written treaty which would not force inconvenient binding and quantified emission-reduction-actions. They also wish India, China, Brazil and South Africa to join the industrialized countries. India has maintained the position that "the end of Kyoto Protocol is not acceptable to us. It is a legal pact with rights and duties for all Member Countries. A handful of countries wanting to abrogate their duties cannot kill it on their whim." Our Foreign Minister, Shri S. M. Krishna called upon the developed countries to commit and deliver significant reduction of at least 40% in their emission by 2020 from the agreed 1990 base line. He addressed an UN Meet on Climate Change on September 20, 2009 that any move forward on this issue to be deliberated in Copenhagen in December 2009 meet should take into account the rights of developing countries to pursue growth and poverty eradication.

09.08 India's position virtually applies to all developing countries. No international instrument (like Kyoto Protocol) should be set aside in a light manner. India's "Stake in successful, meaningful and ambitions outcome" is much greater than that of the developed block.

09.09 Change in the Arctic Summer Sea ice has become visible. A study conducted by Colorado University's National Snow and Ice Data Centre, informs that Arctic ice coverage is the third lowest since satellite records began in 1979 (Times, London). Add to that the Himalayas melting; animals in North and South Poles decaying; 40% people not getting protected drinking water; sea level rising; ground water depleting. Is it what we wish to transfer to our succeeding generations ?

09.10 Climate Change with its horribly resultant ramifications knows no geographical or political boundaries. It is a Universal Problem.

09.11 Overcoming Climate Change is, as such, number one challenge of the 21st Century. There is a strong and inescapable need for a reduction of GHG emissions to a sustainable level as discussed earlier. Engineers are the architects behind every energy system and we hold valuable knowledge of the new sustainable technologies and solutions that are too important to society and decisions makers to be ignored.

09.12 The Institution of Engineers (India), to address this important matter, has already established a Centre for Climate Change at its Engineering Staff College of India (ESCI) at Hyderabad with the aim of creating awareness, finding engineering solutions and helping implementation of Clean Development Mechanism (CDM). The Institution also participated in an International Project, "Future Climate ; Engineering Solutions" in association with twelve other engineering institutions of eleven countries. The project aimed at preparation of Climate plan of respective countries and then arriving at synthesized global plan to the Climate Change problem. The project was handled by our Centre for Climate Change with extensive discussion and consultations with the experts within the country. The project concluded that the existing technologies are sufficient to find solution to the Climate Change issue in short term and emerging technologies would be adequate to address the matter in long term. It is for the respective Governments to realize the urgency and to take definite policy decisions and compliance steps suggested and designed by the technologists and engineers. The Institution of Engineers (India), as a premier body of engineers, has taken up the task of addressing the issue within the National Action Plan for Climate Change of India.

09.13 The Supreme Court of India delivered an order way back in 1991 that 'a separate compulsory subject on environment' should be introduced and taught from "primary to University level of education". This requires to be thoroughly implemented by all concerned authorities and agencies responsible for designing and executing the education system to inject awareness and create strong mindset towards environment and climate protection.

10.01 The Institution of Engineers (India) has been playing a dominant role in shaping and promoting the Engineering education in the country. The Institution was responsible for according accreditation to the engineering colleges and institutes and their curricula of teaching for several decades till AICTE was established and took up the work. The Institution of Engineers (India) had rigorous set of norms and very high standards to measure and adjudge the standard and level of engineering education which a particular Institute/College was capable of providing. During those days not even an iota of suspicion could be raised from any quarter. There was a wide ranged feeling of confidence that if the Institution had accorded accreditation, it had to be an excellent institute, a 24 carat gold.

10.02 The Institution also has been imparting non-formal engineering education since 1928 to the working technical personnel who wish to upgrade their engineering educational qualification. There is no parallel to what it has contributed to create engineering work force to supplement and meet the requirement of the country. As of now it is turning out 1500 to 2000 qualified engineers each year at a very low cost to them. The Graduates of the Institution are recognized by the Government of India as equivalent to engineering graduates with BE Degree and this is accepted by MHRD, UPSC and different state Governments.

The Institution holds Annual Convocation at its different Centres around the country where successful students are awarded the Graduate Degree of The Institution of Engineers (India). This year's Convocation was held at Cochin and His Excellency Governor and Chancellor of Universities in Kerala and the Vice Chancellor IGNOU, New Delhi and The Institution's President addressed the Convocation and awarded the Degree.

This impressive function precedes each year by an 'All India Technicians & Students' Convention with technical seminars to promote, motivate and encourage young talents.

10.03 The Engineering Staff College of India (ESCI) established by The Institution of Engineers (India) at Hyderabad as its autonomous organ, is an excellent Centre of Learning for practicing engineers. It has been at the fore-front of ushering in advanced techniques, new-age disciplines and industry-driven training and continued professional development courses. It has been also providing customised training, tailor-made to suit the requirements of working engineers and technical personnel of various Govt. departments, power utilities, public undertakings and industries of the country and abroad. The ESCI is aspiring to obtain the status of a University under the aegis of the Institution. It has all the basic infrastructure and ambience required for the same. We take pride in informing this august intellectual assembly that this prestigious educational unit of The Institution has bagged the coveted National/International Golden Peacock Award consecutively for the last three years for excellence in Corporate Governance (Training).

10.04 The Institution of Engineers (India) has been alive to the requirements and standards of Engineering education not only in the country but in South and Central Asian Region. It participated in a Seminar organised at Colombo October 2-3, 2009 by the Federation of Engineering Institutions of South and Central Asia (FEISCA) on a very topical theme "Is The Present Engineering Education Geared To Meet The Current Regional Challenges?" IEI presented a paper on "Emerging Trends And Challenges For Engineering Educators To Educate Tomorrow's Engineers" through one of our esteemed Past Presidents, Shri R. P. Gupta, FIE. It contained very valuable material which can prove to be a trend setter. The Institution is editing the papers presented there by eminent authors of the constituent countries, to present the same to the Govt. of India, MHRD as, in our opinion, it may provide useful inputs for orienting engineering education policies for tomorrow. IEI holds the chair of the Senior Vice President in FEISCA. The delegation including myself and the Senior Vice President participated in FEISCA Executive Assembly meet which was concurrently held there.

10.05 Our Scientists, Engineers and Technologists and even students of general educational area of art, literature, commerce and science have been doing wonders in all corners of the globe. They are second to none. However, it is disappointing that none of our Universities found place in the gradation of the first one hundred universities of the World as reported recently in the National Dailies. Unless we accord primacy to bring in improved technology in our educational affairs and design the system appropriately, our salvation may remain a far cry. We have to be alive to this unvarnished truth. Let us not lose sight of the fact that education in India can be a roaring success only when it is addressed to the basic concerns of the community, society and nation. Divorced from harsh realities, no policy has the dog's chance of succeeding and giving shape and substance to our much-cherished dreams. Imported schemes without any flavour of domestic essentials can not work.

11.01 India has witnessed a rapid progress in the aerospace segment also during the past few decades. In the space arena, we have achieved self reliance in Satellite-launch vehicles. Our engineers have operationalised PSLV capable of launching Indian Remote Sensing Satellites and multiple small satellites with fifteen consecutive successful flights. Another notable development is the development of indigenous cryogenic stage which will be flying in the GSLV-D3 mission this month. India got laurels internationally with the successful launch of Chandrayaan-1, the prestigious first unmanned lunar exploration of the country. In the satellite segments the country has achieved self-reliance in the Earth Observation and Communication Satellites and is embarking on development of Navigation and satellites and scientific satellites for measuring aerosols.

11.02 In the defence aerospace area the country has developed a series of missiles based on different technologies and application like, Prithvi, Akash, Trisul, Nag, Agni, to name a few. The BrahMos (Brahmaputra-Moscow) missile, an Indo-Russian collaborative venture stands testimony to the co-operation in the international segment. Information dominance is going to be the key factor in 3D battle space of the future and the country has entered the Unmanned Air Vehicle (UAV) race with LKAKSHYA the target aircraft and NISHANT, the tactical UAV. This decade saw the flight testing of the Light Combat Aircraft (LCA) also.

11.03 Our engineers have developed a series of inhouse technologies during the development processes which were not readily available and that could not be acquired from elsewhere. This has also got applications in other areas for the betterment of the people.

12. In other areas of Engineering and technology also, quantum-jump in their development has taken place. Be it Railways, Steel Sector, Coal Sector, Surface Transport, Navigation, IT, Energy Sector, Defence, Chemical and Metallurgical industry or think of anything anywhere in the country which provides service or contributes to standard of living, you will find that technology and Engineering is there. And I can assure with confidence that, in any and every such endeavour you will find that a member of this Institution is certainly a part of it.

13. As most of you might be aware the Institution's activities are already transnational. We have five overseas chapters in Gulf Countries (Abu Dhabi, Bahrain, Dubai, Kuwait and Qatar) where our engineers and technicians are working in large number. We are in close inter-action with all these chapters taking care of their engineering and technological interests.

14. The Institution of Engineers (India) is an important Member of the World Federation of Engineering Organisation (WFEO) with its headquarters at Paris. We are the only country chairing a Committee (Technical Committee ComTech, as Vice President) as well as holding an elected Vice Presidentship. We have also an additional Member in WFEO's Energy Committee and in ComTech.

In WFEO's General Assembly 2009 held at Kuwait during last month (November 01-06), IEI had the honour of addressing its General / Executive Assembly on Climate Change and Infrastructure Development in Developing Countries as the Theme Leader. The ComTech Vice President made a substantial proposal on expanding and enlarging the activities of the Committee on Technology. We shall make all efforts to project India's interests and strengthen our position during the coming year(s).

15. We are a constituent member of Federation Internationale du Beton (fib) headquartered at Geneva, Switzerland. The Institution has constituted the Indian Member Group of the fib-Council and also the Indian member Committee of fib (IMC-fib). We have made a bid for organising and hosting fib World Congress in India in 2014 and are likely to get it. Preparatory action for the same has already been initiated.

16. IEI is a constituent Member of the World Mining Congress (WMC) which has its headquarters in Poland. We hold the Vice Chairmanship of WMC and have constituted the Indian National Committee of the said World Mining Congress (INC-WMC). It has support and participation of the Union Ministries of Coal, Steel, Power, Environment & Forests, Space (Remote Sensing Agency), Planning Commission, CSIR, Departments of Science & Technology, Steel Authority of India, NTPC Ltd., Indian Bureau of Mines, Indian School of Mines, Dhanbad, and various other ogranisations, corporations and Industries concerned and associated with the minerals and mining. The Institution of Engineers (India) has been playing a key role in the activities of WMC and participating in all international conferences. It has been making all efforts to keep abreast with latest technology and know-how and also to disseminate it to all concerned.

17. IEI had been the founder member of the World Energy Council which is a global body constituted with member Committees in nearly 100 countries world-wide. The Indian Member Committee of WEC (WEC-IMC) is a non-profit organisation committed to enhancing the effectiveness of the National energy strategy. The IMC seeks to forge a better understanding of energy issues among the public and private sectors and the country at large, through discussions and exchange of information on all forms and aspect of energy. The Institution of Engineers (India) is at present a Member in the WEC-IMC hosted by the National Thermal Power Corporation, New Delhi and chaired by the Power Secretary with Hon'ble Minister of Power as its Patron. The IMC is supported by the Ministries of Coal, Petroleum & Natural Gas and New & Renewable Energy and Ministry of External Affairs.

Under an MOU with WEC-IMC, NTPC Ltd., and the Institution, a Knowledge Networking Forum has been created which is working actively to propagate and create awareness on Power Sector Reforms and development throughout the Country utilizing the infrastructure of the Institution available in its nearly 100 State and Local Centres throughout the Country. IEI provides a unique forum for cross-fertilization of ideas and know-how.

18. IEI is also a founder Member of the Commonwealth Engineers' Council (CEC) in London, U.K. which is charged with the obligation to forge co-ordination, inter-action and exchange of developments in Science and Technology amongst the Professional Bodies of the Commonwealth Countries for advancing their mutual interest in the matter.

19. We have recently made ourselves a constituent of the Federation of Engineering Institutions of Asia & Pacific (FEIAP). Our first formal participation in its General Assembly took place during November 30 to December 02, 2009 i.e. only a few days back at Singapore.

20. Indian Engineers Attain World Mobility : With the removal of barriers under WTO and GATT regimes, quality assessment of professionals for transnational mobility has assumed very important dimensions. The Institution of Engineers (India) had been making efforts for quite some time to develop system and processes for certifying Professional Engineers to International Standards. We had initiated steps for voluntary certification of PEs. right in 1993. The systems and procedures operated by us and our other participating professional institutions were witnessed by a team of the World Body consisting of its representatives from UK, Japan and Hong Kong. The Institution of Engineers (India) had been awarded the provisional membership of the Engineers Mobility Forum (EMF) in 2003 and had been striving hard consistently for obtaining its permanent membership. The procedures and system adopted by us was again inspected and monitored by experts from UK, Japan, Korea, and Australia who expressed their satisfaction and informed that our procedure was much more effective than that in their countries. The Institution of Engineers (India) finally got the Permanent Membership of EMF this year on 17th June during the biannual International Engineers Meeting 2009 at Kyoto, Japan. With IEI becoming part of the International Agreement on Mobility, on one hand, Indian Professional Engineers would be readily acceptable to practice in foreign countries and on the other hand, a system for quality certification of incoming engineers would be easily available for employers in India. Additionally, PEs. certified to International Standard would command higher recognition and weightage in domestic market.

This much awaited development would provide level-playing field, mobility and recognition to Indian Engineers.

21. The Institution of Engineers (India) has agreed to the necessity of having an Engineers Act. With rapid overall social and economic development, it is essential that the engineers are made accountable for their actions by regulating the profession. The draft Engineers Bill envisages and provides for compulsory registration of all practicing engineers as well as the fresh engineers coming out of various universities and competent professional societies like IEI, IETE etc. and who wish to practise and serve in any field of engineering. The Draft Engineers Bill framed and agreed to by The Institution of Engineers (India) and various other professional societies has been submitted to the MHRD, Govt. of India. It is under the formal processing there.

To regulate the conduct of its members the Institution has already got a very strong and stringent set of well-specified Code of Ethics. To enforce the same we have an equally strong mechanism and authority in place. It works administratively and judiciously following the norms of natural justice.

22. I sincerely wish to inform the house that some vested elements in the profession with dismal following have been trying to give twists and turns in the well-meaning initiatives and proposals made in the best interests of the engineering profession. The profession may be well

advised to beware of such elements who, taking advantage of their presence in the National Capital have been, of late, putting obstructions here and there.

We have to create and develop a strong and effective mechanism and presence in the capital of New Delhi, in addition to what we have at our Headquarters, to ensure that the objectives well set by the Institution and other well-meaning professional societies are pursued appropriately, adequately and in time.

23. In this World which has become so close, an organisation like ours, cannot afford to live in Isolation because the Science, Engineering and Technology do not know any geographical and territorial barriers. Therefore, the Institution has entered into bilateral agreements and memorandum of understanding (MOU) with several Professional Societies and Associations in the World.

Apart from the FEISCA and Gulf Countries as already discussed, we have bilateral and active reciprocal professional ties with the :

Union of Scientific & Engineering Associations (USEA), Moscow ;
China Association for Science & Technology (CAST), Beijing ;
Polish Federation of Engineering Associations (NOT), Warsaw;
American Society of Civil Engineers (ASCE) ;
American Society of Mechanical Engineers (ASME);
The Institution of Civil Engineers, London (ICE), UK;
The Institution of Engineering & Technology (IET), UK;
Japan Society of Civil Engineers (JSCE), Tokyo;
Korean Professional Engineers' Association (KPEA), Seol ;
Danish Society of Engineers, Copenhagen, Denmark ;
Canadian Society for Mechanical Engineering
Engineers Australia, Victoria, North Melbourne
Association of Engineers, Architects and Graduates in Technological Sciences in ISRAEL (IEAI), Tel Aviv;
Honk Kong Institution of Engineers (HKIE) ;
Federation of the Scientific Engineering Unions, Bulgaria ;
Union of Engineers and Technologists of Yugoslavia, Belgrade ;
Federation of Technical and Scientific Societies, Hungary, Budapest ;
and many others.

24. The Technology is developing at a breath-taking pace and is entering its most exciting era. We have to move with a commensurate speed. In this razor-sharp competitive world of today, one has to have a cutting edge. We have to seek to expand our mental horizon by attuning us to what is current trend and thinking.

25. Though it is “miles to go” before we can be at par with the more developed nations of the world, there can be no denying that we have forged ahead and achieved spectacular results by application of science and technology in our work-a-day-world. We have reasons to hold our head high and feel the sensation of national pride when we recall that we have almost the largest reservoir of technical skills and expertise in the world.

26. We, in The Institution of Engineers (India) are truly aware of our weaknesses and strength. We are equally alive to the opportunities we have before us to better and optimize our service to the nation and the mankind which we have been performing for the last nine decades through our multi-dimensional activities.

27. We have our establishment and offices in the capitals of States and in other important

educational and industrial cities of India. The Institution did not have its established Centres in remote North-East States. Last year we brought necessary changes in our Statutes to have a State Centre in all the States irrespective of the strength of our members there. This has been done with the objective to contribute to technological development of the North-East Region particularly. We are taking steps to establish our State Centres in all these States one by one during 2010.

28.01 Our members and technicians, from wherever they are locatedand from wherever their work place is, are sincerely committed to do their best. There is no room to relax. We rededicate ourselves to create an environment and ethos to enable pursuit of professional excellence for engineering fraternity in the country and abroad to maintain and keep up our pre-eminent position as a professional body to continue to contribute to the development and application of the art, Science and business of Engineering and Technology for better service to the nation and for enlargement of national wealth. We reiterate our pledge to contribute effectively in the national efforts for sustainable developments, whilst ensuring protection of environment and ecology. We reaffirm our commitment to foster and facilitate research and interactions in basic as well as in emerging technologies in close collaboration with academy and industry.

28.02 When we say this, we are sure that our team of devoted and sincere officers and the vast reservoir of talent, skill and knowledge available with our more than 6,34,000 corporate and non-corporate members, spread throughout the length and breadth of our motherland, are pledge-bound to work towards these objectives. We have to combine mission and business.

We have to design a 360 degree sweep which goes from the issues at grass roots to the global concerns.

29. I, on behalf of The Institution of Engineers (India) and also on my behalf, thank you all from core of my heart for participating in this Indian Engineering Congress which is the apex function of the Institution. I, very sincerely make a fervent appeal to each one of you to kindly extend your support in all manners to this Institution for achieving success in its mission. We call upon all our engineer brothers to join us for the sake of promoting and enhancing the cause of professional fraternity and also to avail the rights and privileges which a member of The Institution of Engineers (India) enjoys. Let us grow with The Institution. Let us march together. Let us put our step forward and find that "एक पाँव रखता हूँ, हजार राहें फूट पड़ती हैं" ('मुक्तिबोध' कविता). I put one step forward, and a thousand of paths open (in my front).

May God, the Almighty enlighten our path to glory and prosperity beyond measures.

JAI BHARAT,

JAI INSTITUTION.

The inputs and various data taken from the following sources are gratefully acknowledged :

(i) Electrical India, a very informative and authentic monthly journal on Power

(ii) National Dailies like, The Times of India, The Hindu, Indian Express Editorials and news

(iii) "Prabhat Khabar", a very popular Hindi News Daily in Bihar, Jharkhand and West Bengal (Eastern Region).

Shri Madan Lal —a Brief Profile

Shri Madan Lal had a very brilliant educational career throughout. He was one of the top scholors of his home State at matriculation and Intermediate (Science) stage. He obtained his Bachelor's degree in Electrical Engineering in 1961 from Bihar Institute of Technology, Sindri with high first class. He was a TATA Scholar at BIT. He did his LIB from Magadh University in 1986.

He joined Bihar State Electricity Board in 1961 and rose to the position of Chief Engineer (Projects and Design). Apart from his contribution in the fields of generation, supply and distribution of power, he has specialisation in the field of Extra High Voltage (EHV) Power Transmission System in which he worked for nearly two decades. He underwent a specialist course in Extra High Voltage Power System Switchgears and Power System Protection at the then Roorkee University (now IIT Roorkee) in 1972. He also underwent a training course organized by the Bureau of Indian Standard at Bhubaneswar on Standardisation of Cables and EHV Conductors in 1987.

A singular land mark in his career as a field executive was the creditable execution and commissioning of the prestigious 90 kms long 220 kv Inter-State EHV Transmission line in a record span of 90 days (August-October, 1979) against overwhelming odds posed by the monsoon. This received a national commendation.

He has been on the Senate of Patna University for the last seven years. An advocate on record in the High Court of Judicature at Patna and a Member of Patna Bar Association, he specializes in Techno-legal matters and is an Arbitrator on the panel of various national bodies like The Institution of Engineers (India), FICCI, NHPC and Indian Council of Arbitration.

He has been a delegate to many national and international conference which include Workshop on International Commercial Arbitration in Washington DC, 1998 (USA), International Conference on Commercial Arbitration, 1999 (New Delhi) ; World Mining Congress, 1999 (New Delhi) ; SAARC Conference on Arbitration Law & UNCITRAL Model Law, 2000 (New Delhi) ; World Congress on Sustainable Development, 2000 (Kolkata) ; World Congress on Disaster Management, 2004 (New Delhi), Executive Assembly of World Energy Council 2008 (Mexico City), FEISCA Executive Assembly and Conference, October, 2009 (Colombo) and General Assembly of Federation of Engineering Institution of Asian & Pacific (FEIAP), November, 2009 (Singapore). He is a Fellow the IEI (FIE), Fellow of the International Council of Consultants (FICC), Fellow of Indian Council of Arbitrator (FICA) and a Fellow of the Indian Institution of Technical Arbitrators (FIITA). He joined the IEI in 1968 as an Associate Member (AMIE) and was elevated to Member (MIE) and then to Fellow (FIE) in 1986. He served the Bihar State Centre of the Institution as Joint Secretary for six years (1982-88), Honorary Secretary for four years (1988-92) and Chairman for two years (1992-94). Since then he continues to be a Council Member of the IEI.

He has been a Member/Chairman of various Committees of the IEI, such as, CATE, Finance Committee, Bye-Laws Committee, FEIASCA Executive Committee, RCC, to name a few. Shri Madal Lal is a former Vice President of The Institution, is also Member, IMC-WFEO, Governing Council of Engineering Staff College of India, on the Board of Governors of the Sustainable Development Forum of the Institution, and on the Board of Management of ESCI.

Mr G Prabhakar

President 2010-11

Presidential Address

It is my privilege and honour to be amidst a galaxy of esteemed dignitaries, luminaries of the academic world, and top rung engineering professionals from various parts of our country and neighbouring countries for the inauguration of 25th Indian Engineering Congress organized by the Institution of Engineering (India), hosted by Kochi Local Centre.

I feel it appropriate to remember on this occasion the doyens of engineering profession who, with self-less dedication and commitment, contributed to the development of engineering and the country for its progress and prosperity such as Bharat Ratna Sir Mokshagundam Visvesvaraya, Dr. A. N. Khosla, Dr. Triguna Sen, Padma Bhusan Dr. K. L. Rao, Nawab Zain Yar Jung Bahadur, Er. Dildar Hussain, Dr. M. S. Thacker and any other illustrious engineering personalities, who were also at the helm of affairs of this August Institution and responsible for its growth in all directions with their devotion, dedication and leadership.

I am conscious of the honour conferred on me by distinguished members of the Council of IEI for electing me to the highest office of its President. I am indeed grateful to them for this great honour and am aware of the generous appreciation, kindness and confidence behind it. My sense of elation is, however, not unmixed, with some fear of heavy responsibility I am undertaking to steer the activities of this great Institution in the cause of the Nation. I pray to the Almighty to shower his blessings to maintain the traditions and high standards set by my many predecessors particularly, Mr Madan Lal, Rear Admiral K O Thakare, and Mr R.P. Gupta. I solicit wholehearted support and cooperation of them and the fraternity in this great endeavour and keep the flag of the IEI flying high.

The Institution of Engineers (India) was established in 1920 by the untiring efforts and good offices of Er. Thomas Holland in Calcutta. It was registered in Madras as a Society. It received the Royal Charter in 1935 from King George V whereby Indian Engineers were entitled to use the appellation of Chartered Engineers. This was indeed a land mark achievement.

Engineering Science is today no longer an uni-disciplinary subject but a multi-disciplinary science. The Institution of Engineers (India), a multi-disciplinary body of Engineers can claim credit for this transition and development of an integrated approach by its holistic espousal of the real purpose, context, content and nature of the engineering profession in the country. It is therefore, gratifying to note that the Institution has over 6.4 lakh corporate and noncorporate members belonging to fifteen engineering disciplines with 101 State and Local Centers. In addition, the Institution has five Overseas Chapters at Abu Dhabi, Bahrain, Dubai, Kuwait and Qatar. IEI is member of various international professional bodies like WFEO, WEC, WMC, fib, FEIAP, FEISCA and many other Professional Societies and Associations in the world and is contributing to the betterment of engineering community as a whole. It is indeed a great pleasure to mention that our Institution got the permanent membership of Engineers Mobility Forum (EMF) which enables mobility and gives recognition to Indian engineers.

Not only should we grow and prosper as engineers, but also make the engineering profession alive to the needs of the nation. Our work must help us to grow and help society to prosper and in the process, bring about congruence and harmony. In order to accomplish this objective, IEI has established different Fora which are serving the society and the nation with appropriate levels of dissemination. The Engineering Staff College of India (ESCI) of the Institution is engaged in organizing various professional development programmes including postgraduate courses for practicing engineers and technologists. National Design and Research Forum (NDRF) another forum of IEI, is to identify the talent and extend support in furtherance of research and development of emerging areas of engineering. Similarly, Rural Development Forum (RDF), Water Management Forum (WMF), Sustainable Development Forum (SDF), Safety and Quality Forum (SQF) are relentlessly working to accomplish the respective objectives by reaching out to the relevant areas of operation.

The engineering divisions are organizing various activities like Seminars, Symposia, Workshops, National Conventions throughout the country on very important themes and sending recommendations to concerned authorities. The Indian Engineering Congress is the apex activity of the Institution where we have an assemblage of professionals, members from all disciplines of engineering and also the elite of the society. The discussions and deliberations that take place in the Congress will make us conscious of the social responsibility of the engineers.

The engineering profession is as old as human civilization. Engineers are the inheritors of a hoary past and rich legacy. It is described as the professional art of applying science to the optimum conversion of the resources of nature to benefit mankind. Engineers are increasingly realizing and appreciating that engineering as a science is indeed global in character and reach. But technology is and must be local and focal while engineers must be more vocal! Our country demands that engineers convert their knowledge of engineering science into technology for local and appropriate use. People living in most parts of South India still remember and pay tribute to Sir Arthur Thomas Cotton, why? At a time when engineering science was not well developed, he looked hard at the local problems and applied his own mind to visualize solutions and solve local problems despite the limitations of the then available state of knowledge. To what extent we apply our science, our knowledge in solving the problems of the human beings is also a test of our social conscience. We need to think deeply about our problems, choices and options and act decisively on appropriate solutions that are cost-effective.

Engineers have to be increasingly concerned not only with the depth of knowledge, but more so with the width of knowledge. They must gain the width of knowledge by becoming multi skilled, versatile and develop an attitude of continuous learning. And pursuit of 'Excellence' should become a habit to enable us to move closer to the goal of perfection. If the country has to benefit, the large number of engineers in the country and particularly, the new engineers from the numerous colleges will have to imbibe and develop a higher level of consciousness about the importance of time, cost, quality, productivity, profitability and ecology and inculcate these values in the corporate sector and all walks of life. Unless this is done, we cannot feel the positive impact of the engineering profession on the country's progress.

There is a growing recognition in the Institution and among engineers that engineering is not confined to only engineering work but it must have a much larger perspective, more meaningful purpose and greater impact on the lives of people. The main issue is to make engineering a transforming, reforming, performing, trans-cultural, trans-national, and global by way of 'reaching out' knowledge and teaching people to apply knowledge to help the society. Knowledge, unless it helps society to progress, does not have much meaning, purpose or content. High Tech must indeed become High Touch and All touch.

What makes a country worthwhile to live is not the highrise or majestic buildings or the magnificent temples of awesome antiquity or vast rivers or high mountains. It is the people and the spirit that reside in them which make a country strong and great.

'Nations have passed away and left retraces and history gives the naked cause of it. One single, simple reason in all cases, they fell because their people were not fit.'

And one essential requisite that makes people great and enable them to overcome obstacles and make progress in the desired directions is knowledge.

It is, therefore, very essential for professionals to keep themselves abreast of the latest developments and innovations going on around the world in their respective disciplines.

History has shown that modern economic growth has been inspired by a rapid and persistent upgradation of technology and scientific knowledge. It is estimated that from one-third to one-half of the growth, experienced by the industrially advanced countries, has come from technological progress. Thus, technology has emerged as the principal driving force for long term economic growth. Economic growth results both from slow and steady improvements in technology as well as from the 'break through' inventions. Break through inventions are, however, unpredictable and such inventions change almost the direction of the entire industrial structure. Scientific discoveries and the consequential technological changes have completely revolutionized the life style and living standards of people.

Old concepts are crumbling and the new ones are emerging. Many of the things that gave support and meaning to our lives are disappearing. Institutions that we relied on, particularly the work organizations are no longer so sure and so certain about their objectives and goal. Social and ecological crises and massive institutional break-downs are visible on a scale unheard of. It seems that the rate of change will last for ever and continue to accelerate to devastate whatever is existing. Engineers and technologists have to decide very fast much faster than might have been imagined even till the other day. There will be only two kinds of engineers in the days to come the quick and the dead.

Amid all the chaos, engineers must reassess and review the present and define a new order and lead the society and industry into a new world with a new outline on a new canvas.

We witnessed that the previous century was marked by a plethora of inventions and discoveries. The technologists, scientists and academicians had moved giant wheels of industry and had given a new perspective, purpose and promise to plenipotentiary technology. For developmental activities, industries, commercial organisations and business houses mostly depended on physical and material infrastructure.

As perceived by many technologists, primarily three trends would emerge in the present century.

First – fundamental and phenomenal changes in technology

Second – the process of globalization would gather further momentum and new technologies would not recognize geographical frontiers. Speed in communication would accelerate flow of goods and services along with finance that also would result in greater human mobility.

Third – all countries would become aware of the changes happening all over the world and developing economies would naturally demand that their aspirations were met.

Within a decade, we could realize that the perceived trends are making their mark with signals for wide spread changes.

The developments in computer and communication technologies have accelerated the process of integration, with geographic distance becoming less of a factor. Borders have become porous and the sky is open. With modern technologies which do not recognize geography, it is not possible to hold back ideas either in the political and economic or in the cultural spheres. Each country must prepare itself to meet the new challenges, so that, it is not bypassed by this huge wave of technological and institutional changes.

The scope and application of nanotechnology is tremendous and mind-boggling. According to scientists, 21st century would be the nanotechnology century. It is estimated that it would revolutionize every area; be it medicine, aerospace engineering, various industrial and technological areas, health or any other field. Nanobiotechnology can make tiny medical devices and sensors with fantastic military and civilian use. Converting sunlight into power, targeting a drug to a single malignant cell, cleaning ponds and creating sensors in the form of biochip to be inserted in human body, are some of the landmark breakthroughs of nanotechnology.

The 21st century has ushered in a new era in all directions. With massive urbanization, rapid industrialization, liberalization of economy and an increasing complexity of urban life, there are greater demands for planning, architecture and allied professions. Consequently, philosophy and technique of education and training will also undergo significant changes. Students in these fields must understand and appreciate new technological forces that may shape built environment and take up design to meet changing needs. Progressive development of rational, contemporary planning and architecture, which respond to needs of society and foresee trends of tomorrow, require fundamental re-examination of present principles and methods of education and training in design-based subjects.

Science and technology have given us power and possibilities to harness nature's bounty for conversion into useful products and services. The gravity of urban crisis requires planners to re-examine basic concept of city and rural area. Development without destruction should be a cardinal principle. Prospective engineers must help us to prepare viable blueprints for planning and construction of satellite towns throughout the country.

The IT revolution is changing concept of work and workplace. Many non-metros have benefitted from these changes. As local economies grow in size, markets too will diversify and more jobs will be in place in and around these cities. More small towns could reap benefits of emerging economy, if local governments pursue right policies. The task before the government is to make policies to ensure that urban amenities presently available only in big cities reach small towns and even villages. For this purpose, a seamless network of small towns and villages could be built up, well connected by roads and communication links.

While one segment of the society may be in a position to adopt new technologies, a very large segment may find it difficult to fill the gap, even though some leap frogging in technology is possible. We have to find effective answers to both the challenges. For the large mass of people engaged in various productive activities, we will have to find out what is the relevant or appropriate technology in the changed situation. The changes of this century can be met only by knowledge accumulation. One with more knowledge will be the winner in the market.

The embodiment of technology in physical capital has long been recognized, the importance of the embodiment of technology in people has been recognized only recently and this aspect will assume even greater importance in near future.

Agriculture sector in our country witnessed many revolutions. Green revolution did shoot up the productivity which though resulted in more profit, but the living standard of farmers could not be improved barring a few cases.

Paddy crops were cultivated in an area of 155 million ha in 2007 against 115 million ha in 1961. The rice production was increased to about 635 million tons in 2007 from 216 million tons in 1961.The production target of 760 million tons in 2020 seems to be improbable since growth rate of rice production is declining. Even more alarming is the increasing addition of methane of the order of 40 million tons per year into the atmosphere, just as we grapple with huge gaps between supply and demand of our principal source of food. The resulting crisis is of not only food security but also of health security. The problems of food production and degradation of environment need to be tackled by adopting a holistic approach and educating the people on the need to act together so that we recreate and pass on a better environment, free from pollution to our future generation.

'The resources are not a legacy of the past and present generations but a loan from our future generation.'

Water is one of the prime inputs to agriculture. Water resources in India are regarded as one of the vital assets. India receives an annual precipitation of about 4000 cubic km but the utilizable water resources are assessed as 1086 cubic km.

Imported and indigenous technologies should be blended together consistent with the existing conditions in such a manner that the final product addresses this problem and not only eradicates poverty, ignorance, disease, inequality of opportunity but also provides basic human requirements such as adopting better practices for drinking water, roads, medical care, education and also to save the planet from climate change hazard. We the engineers need to play a very important role with determination and commitment in this sacred cause.

Dr. Zakir Hussain, former President of India had once stressed the role of engineers in laying sure and sound foundations of our economic development in India and said:

'In this war against poverty that we have launched we require the services of a vast army of first rate-engineers to be professionally more competent and skilful and also to be imbued with a passion to serve our people.'

National priority in rural development sector is obviously on ensuring income generation and employment generation activities for the poor people in rural and remote areas.

Technology innovations to address the human misery are inherently causing the climate change threatening the human life on the planet. Our national leaders, Atomic Energy Commission and many experts are advocating Nuclear Power for energy security of the Country, but extensive studies have shown that the Nuclear Power is neither the answer to modern energy problems nor a panacea for climate change challenges. In this context, reorienting the planning and budget priorities for vibrant R&D into the potential of renewable and non-conventional energy is extremely important.

Energy efficiency is widely regarded as the most important step in making the transition to a low carbon economy together with renewable energy. The need of the hour is to conceive energy efficient building design & construction, lighting solutions, electricity grids and industrial machinery systems which can help in optimizing energy usage thereby providing the co-benefit of abatement of the green house gases. The Energy Conservation Act and the National Action Plan on Climate Change provide a frame work for stimulating demand for more energy efficient products, which in turn would lead to enhanced energy access, greater energy security, improved local environmental quality as well as lower carbon intensity of the economy.

Every year, the world and to a greater extent our country witness great destruction of life, property and prosperity due to undisputed effects of Climate Change. The available resources, strategies and solution to address the problem must be analyzed and the policies must be put in place for training the stake holders to mitigate the problem. In this direction, our Institution has established the Centre for Climate Change in the Engineering Staff College of India.

The Prime Minister's Council on Climate Change approved the National Mission on Enhanced Energy Efficiency (NMEEE), which will enable about Rs. 75,000 crores worth transactions in energy efficiency, in doing so, by 2015 it will help save about five per cent of our annual energy consumption.

The Mission is the second of the eight missions under India's National Action Plan on Climate Change approved by the Council.

The NMEEE has undertaken to popularize the concept of Enhanced Energy Efficiency (EEE) with the main objective of minimizing the use of conventional energy to combat climate change. To motivate organizations to practice EEE, NMEEE has devised a very innovative scheme called PAT (Perform, Achieve and Trade), wherein high performers can trade their energy efficiency through the medium of Energy Saving Certificates (ESCERTS). With a view to help organizations, especially in the SME sector, to implement measures of EEE without major investment, NMEEE is promoting Energy Services Companies (ESCO's) in a big way. Again, to inspire confidence of Banks to Finance ESCO's NMEEE, a Risk Guarantee Fund has been established. NMEEE is also creating a Venture Capital Fund to extend financial support to companies aspiring to manufacture energy saving products. Thus the Mission is all set to make EEE happen in this country with the ultimate aim to contribute to cleaner global environment. In as much as ESM-2008 certification catalyses the voluntary practice of energy smart efficiency (synonymous with EEE) by organizations, NMEEE intends to wield this innovative tool.

The National Intelligence Council (NIC), a division of America's Central Intelligence Agency (CIA), in its 2005 report stated that India and China would be the economic heavy-weights of the 21st century. Barring a few upheavals in these countries, the rise of these two powers is a virtual certainty, according to the NIC. This bold and confident prediction comes in the wake of several other similar reports that also dwell on the inevitability of the rise of India and China. The talk of India attaining or aspiring to be an economic superpower is, therefore, not a mere day-dream unrelated to the realities of the situation.

India, perhaps, stands unique in the degree of its diversity. Apart from racial, cultural, linguistic and social diversities, different states in India also tread different paths toward economic progress. Yet, it is the largest democracy in the world.

We cannot afford the luxury of over-confidence and the complacency and hubris that comes with the thought that we are growing slowly yet steadily. A lot of groundwork still has to be done. Exciting as the prospects are, the road ahead is extremely challenging. Our dreams have to be audacious. Our ambitions have to have that essential element of the 'killer instinct'. We certainly have the luxury of having the essential endowments and competencies that go into building a successful, global economic power. What we don't have, is the luxury of too much time.

The Institution provides the engineering profession with a platform for use in assuming appropriate role in various facets of national development. Let us pledge with all dedication to serve the nation at all times and all occasions and make relentless endeavours for building the Nation. I conclude with a quotation of Mahatma Gandhi,

'The Past belongs to us, We do not belong to the past'

Jai Hind

Mr G Prabhakar —a Brief Profile

Mr G Prabhakar was born in a family of freedom fighters at Warangal, a historical city of erstwhile Hyderabad Dominion.

All through his educational career, he maintained an outstanding scholastic record. He exhibited exemplary talent not only in curricular activities, but also in the extracurricular events. He bagged several State Level and National Level awards.

Association with IEI

(a) As Honorary Secretary, APSC

Associated with The Institution of Engineers (India), A P State Centre since 1970 as a faculty member and Coordinator of guidance classes for the students appearing for Sections A and B Examinations of AMIE. Later joined the State Centre Committee representing Mechanical Engineering Division. Served the Centre as Joint Honorary Secretary for four sessions in organizing several technical activities such as Seminars, Conventions, Lectures and Talks etc. He was unanimously elected as Honorary Secretary in 1994 and served the Centre continuously for four years despite holding a very important officials position in the State Government. He was instrumental for bringing the Centre closer to Government by organizing technical activities on topical themes for the benefit of fraternity and society at large. He took up the responsibility of managing Visakhapatnam Local Centre when it was adumbrated by Court's litigation. With the support of the Committee, close interface could be established between IEI and other technical organizations of repute in and outside Andhra Pradesh. The activities were acclaimed by the Corporate Members and others alike.

(b) As Chairman, APSC

In 1998, the Committee unanimously elected him as the Chairman for two sessions. As Chairman, his services were laudable. A number of national and international activities were organized. While sustaining the tempo of technical activities, he strived hard to improve the financial position of the State Centre. He was also involved to better the relations between A P State Centre and the ESCI. During his tenure as Chairman, 15th Indian Engineering Congress (December 2000) was organized at Hyderabad which of course, received accolades from all the concerned for very meticulous planning and execution of the event. Many dignitaries graced the event. Dr A P J Abdul Kalam also participated and delivered a memorial lecture. A memorable event in the annals of A P State Centre was to receive the "Best State Centre Award" during this Congress, in the very first year of instituting the award.

(c) As Council Member

Ever since he entered the National Council of the IEI in 1998, he has been rendering his humble services to the Institution by being on various Committees and also as Vice President (2002-03).

Some important Committees which he served :

Chairman : Committee for Advancement of Technology & Engineering (CATE); Chairman : Regional Co-ordination Committee (RCC); Member : Finance Committee (Six sessions); Member : CATE (Three sessions); Member : RCC (Two sessions); Member : Indian Member Committee of World Federation of Engineering Organisations (IMC-WFEO) (Four sessions); Member : Service Rules & Headquarters Management Committee (SHMC) (Four sessions); Member : Board of Governors - NDRF; Member : Board of Management - ESCI.

Professional Career

(a) Technical Teacher

He was a Faculty Member in the State Technical Education Department for about 14 long years including one year's service in Osmania University.

(b) Irrigation Engineer

On selection by the State Service Commission, joined Irrigation & CAD Department as Direct Recruit Dy Executive Engineer. He held several important positions in the Department which require *engineering as well as administrative skills. He was involved in formulation of several major irrigation and multi purpose projects and took keen interest in obtaining the clearances for Government of India. The other area in the Department, where his involvement received appreciations was procurement of works relating to externally aided projects. His background of management and law education greatly helped him to earn encomiums from the Colleagues and higher officials in this field of greater intricacies. He was one of the six selected by the World Bank for undergoing the training in "Procurement Procedures" as Washington.*

(c) Resource Person of World Bank

As identified by the World Bank as resource person, he visited Sri Lanka, Bangladesh, Pakistan, Nepal & Bhutan to deliver lectures on procurement procedures. He is a Guest Faculty to many of the Training Institutes in Hyderabad, like Administrative Staff College of India, National Academy of Construction, Engineering Staff College of India and Water & Land Management Training and Research Institute.

(d) Engineer in the Secretariat

He had the rare opportunity of serving as OSD in Government (I&CAD Department) to render advises to Administrators as well as Ministers to take decision on Technical issues. His services were utilized by the Government even after superannuation.

Consulting Engineer

Presently as Consultant, he is overseeing the quality assurance of Irrigation Projects under implementation in the State.

Mr Prabhakar will assume office as the President, IEI, at the Ninety-first Annual General Meeting of the Institution to be held at Kochi on December 16, 2010.

Shri S L Garg

President 2011-12

Presidential Address

It is my pleasure and honour to welcome you all to the AGM of the Institution of Engineers (India) being hosted by Karnataka State Centre at Bangalore. It is really heartening to see the presence of so many most revered Past Presidents. I am indebted to them for their gracious presence. I am also thankful to the Council Members as well as Corporate Members for their presence. It is with great pleasure that I stand before you this afternoon as President of this esteemed Institution for the next term. I appreciate with great honour the Council for having bestowed upon me the opportunity for serving the Institution in this prestigious position.

My contribution to the engineering profession is extremely moderate when compared with the great names of renowned engineers who have been the Presidents of this Institution. This Institution had the honour of being steered by some of the legendary figures in the field of engineering, such as Dr A N Khosla, Dr K L Rao, Dr Triguna Sen, Rai Bahadur Kanwar Sain and many other illustrious engineering personalities. I can assure you that I shall do my utmost to cherish and protect our glorious past and shall endeavour to further aims and aspirations of our great Institution.

For the last few years Indian economy has been growing at the rate of 8% inspite of recession in USA and Europe. This has been possible due to correct economic policies of the Government of India and spread of professional education. Today India has 3900 Engineering colleges with intake capacity of 14.85 lacs students, a similar number of other professionals like Doctors, MBA's, C.A.'s, Lawyers, Architects, Teachers etc are added every year. The country is also producing similar number of technicians, semi-skilled and un-skilled workers. They are important national wealth and great asset in making economy of the country vibrant resulting in prosperous India. This economic growth coupled with population growth and fast urbanization has thrown a big challenge to the nation in general and engineering fraternity in particular for the development of matching infrastructure for Housing, Transport, Roads, Water Supply, Sanitation, Environment, Health Care, Consumer products etc.

Indian Engineers have so far been facing this challenge and the development of infrastructure projects in the country is quite satisfactory but to cope with the enhanced requirement of infrastructure shall be a greater challenge for the Engineers. This strong and consistent economic growth has raised hundred of millions of expectations and inspirations. Fulfilling these expectations and inspirations is real challenge for the Engineers and this will determine the performance of our Engineering fraternity. IEI has been playing an active role in this direction as the AMIE pass outs from IEI are well trained and experienced in their respective discipline of Engineering. I am confident that the Engineering fraternity shall face this challenge successfully and come up to the expectations of the nation.

Special focus of attention shall be :

- To improve and enhance the technical activities so as to attract more Engineers to join IEI;
- To strengthen our current role as Advisor to the Government in a systematic manner;
- The dedicated Research and Development Cell already established at the IEI Headquarters will coordinate with NDRF to promote Research and Development across the Indian subcontinent involving Public Sector Undertakings, Industrial and Large Corporate Houses with IEI.

All of us are aware that there has been a debate on ensuring status of engineers and whether there is a need for Engineers' Act. There are strong views expressed by members of IEI as well as those engineers outside IEI. No single mutually acceptable route has so far been projected by the Government of India. As it happens democratic debate continues till a decision is taken and the debate continues even beyond that decision as the human ingenuity always finds arguments on either side. Engineers' Bill is also one such important piece of document on drafting of which consensus has been a highly debatable issue. It is however, necessary to reach a state of finality on which way IEI will go. I hope the Council will take a final call on the issue.

Role of IEI has been recognized by the international community when membership of Engineers Mobility Forum (EMF) was granted to India, and IEI was asked to maintain country section of register of professional engineers. IEI has established all norms, procedures and standards for certifying engineers as per the EMF requirements. Not only this, IEI has also aligned its procedures of certifying professional engineers with international standards.

The growth of IEI membership as compared to the Engineers produced by the country is not very satisfactory. An effort is required to see that IEI membership grows by 25% every year. A strategic plan and its implementation scheme for achieving the desired growth rate of membership is under active consideration. The Engineers working in Government, Public and Private Sectors including large construction companies need to be approached and encouraged through their parent bodies to become Members of The Institution of Engineers (India).

IEI also needs to maintain and strengthen continuously its interaction with various Ministries and Planning Commission so as to be in a position to prove its value and importance to them. Interaction has to be effective so that all information of the development in different Ministries is made available to the Institution and the Institution in turn is able to develop proposals and impart its inputs in government policy formulation and development programmes. This will need strengthening of the Secretariat of the Institution that will maintain contact with various government institutions especially with Central Government in Delhi. At the same time, the State Centres also need to establish better linkage with State Governments.

It is observed that past events of International Conferences of the World Congresses held in Kolkata (2003) and Delhi (2007) have boosted IEI image nationally and internationally in the professional field. It is necessary to streamline a strategy so that more such international events at National level are conducted in association with international bodies like the WFEO. This is a feasible option, but needs substantial preparation and effective coordination. Different models for executing such a programme exist and it is necessary for different centres of IEI to pick the model they consider appropriate.

IEI also needs to look into developing training courses for personnel, both from the Government Sector and Private Sector to fulfil skills needs of the new programmes that are emerging under the new economic order. The current Five Year Plan has seen Government thrust on skills building programme for which government provides funding for such training programmes. Various IEI Centres have the potential of becoming Nodal Centres for providing skills building training facilities in a decentralized manner at different Centres. Engineering Staff College of India can play a key role to formulate programmes and courses and provide advice to various centres for conducting such training courses.

IEI also has a role in promotion of applied research through its centres. IEI through NDRF, RDC and CATE is already working on establishing few centres utilizing its own resources which are not sufficient. I understand that with some Ministries of the Government of India substantial funds are available for utilization in the field of applied research on engineering aspects. It is necessary to orient our programmes to fit into the policies of those departments with continuous dialogue.

The Institution of Engineers (India) is pioneer in the area of non-formal engineering education program with introduction of AMIE Examinations in 1928. AMIE is recognized as equivalent to a degree in engineering by the Government of India, the Union Public Service Commission, the State Governments and many Public / Private Sector Organization in the country.

Our system of assigning marks in the AMIE examination is such that the students are put to disadvantage while competing for employment with students of other engineering colleges. The reason is that other institutions follow the system for providing marks for tutorials assignments, practical work and projects. These help students score high marks. It is extremely necessary to look into this aspect and endeavour to deal with issue on priority and encourage examination division to promote system of markings that brings AMIE Students at par with the regular students. This will also improve the acceptability of IEI graduates (AMIE) in Government, Public and Private Sectors.

In the era of globalization the government is also trying to undertake development with larger involvement of the Corporate Houses. It is, therefore, necessary that IEI should also attract Corporate Houses into its fold by undertaking programmes that convince them of win-win strategy. The Safety and Quality Forum has already developed a model through its Annual Safety Conventions and the Safety Innovation Awards which are attended by large number of Corporate Houses. Different Fora of IEI and State Centres can further study this model or evolve their own model to ensure larger participation of the industrial Houses in their activities, that will make IEI a more dynamic and member friendly organization. As you all know that IEI has five Autonomous For a and one Autonomous Organ to enhance their effectiveness, usefulness and visibility and revision of their statutes is under active consideration.

Division Journals, IEI News, Technorama and various other publications have been receiving thorough attention every year. IEI News has already undergone a significant modification and has become member-friendly. An effort is being made to publish the division journals in partnership with a leading publishing company to ensure quality publication and improve the outreach of such journals. Technorama has the potential to become an important organ and a medium of image building of IEI.

A number of our State and Local Centres, especially local Centres, are dormant as Technical activities or other activities could not be performed by these Centres. Some of these Centres have expressed the concern for need of higher financial assistance and administrative support for running their Centres effectively. A Committee has been set up to address the issue and necessary follow up action shall be taken so as to make these Centres fully functional.

The recommendations made during National and International Conventions are sent to Govt.of India and concerned State Governments. The follow up action from the Headquarter or State Centres with the concerned Ministries of Government of India / Departments of State Governments is inadequate and ineffective. This needs to be streamlined and strengthen.

As President of IEI, I am taking the baton from Shri G Prabhakar whose contribution in the development of this Institution is commendable. I hope that the valuable guidance of the Past Presidents, active support and cooperation of the Council and Corporate Members shall make my job as President easy.

With grace of god I will try to do my best to come upto your expectations.

Shri S L Garg—a Brief Profile

Shri S L Garg, FIE, has been elected President of The Institution of Engineers (India) for the Session 2011-12, at the 667th Council Meeting of the Institution hosted by the Belapur Local Centre on September 24, 2011. Shri Garg, a Civil Engineering graduate from Thapar Institute of Engineering & Technology, Punjab University, joined Punjab Irrigation Department in the year 1961 and retired as Chief Engineer (Irrigation) in 1995. During his service, he played significant roles in Water Resources Management of Canal Systems, Drainage and Flood Control Management etc. Due to his professional efficiency, good administrative and public relation skills, he was appointed as General Manager of Ranjit Sagar Dam Project — a multipurpose Hydro Electric Project on river Ravi in Punjab. As General Manager, he was the Executive Head of this important project. Due to his immense contribution in this project, Shri Garg was honoured 'Outstanding Civil Engineer' by the Institution during 1999-2000. Shri Garg became the Member of the Institution in the year 1972. As an active and dynamic member, he was elected for the first time to the State Centre Committee of IEI, Punjab, Haryana and Chandigarh in 1975-76. He became the Council Member of the Institution in the year 1991 and is continuing till date. He served the Institution in various capacities, such as, Chairman of the State Centre, Vice President of the Institution, Chairman of the Civil Engineering Division Board, Chairman of the SHMC, AITC, LBC. He was also the Member of Finance Committee, By-law Committee, Regional Coordination Committee. In addition, he is the Chairman of Welfare Trust which runs a full-fledged State-of-the-Art Modern Charitable Diagnostic Centre in Panchkula, Haryana. Shri S L Garg has been selected as one of the three experts to the National Water Mission, Government of India. Shri Garg will assume office as the President at the Ninety-second Annual General Meeting of the Institution to be held at Bangalore on December 18, 2011.

Mr S S Rathore
President 2012-13

Presidential Address

I feel greatly honoured and privileged to be amidst a galaxy of high level dignitaries, celebrities, top rank engineering professionals, academicians from several parts of our country and neighbouring countries who have assembled here for the inauguration of 27th Indian Engineering Congress which is a flagship annual event of The Institution of Engineers (India)—IEI, being hosted by the Delhi State Centre at New Delhi.

I take this opportunity to convey my sincere thanks and gratitude to the National Council of IEI for the confidence reposed on me in electing me as the President of this largest Professional Body of our country for the session, 2012-2013. I feel honoured to be at the helm of affairs of this august body and accept the great responsibility of serving this Institution in the right perspective and steer its activities for the betterment of the engineering community in particular and the society in general. I humbly solicit whole-past president hearted co-operation and able guidance of the learned Council in performing my duties in a pragmatic manner for achieving the contemplated objectives of the Institution.

I am taking over from Shri S. L. Garg who has provided strong and effective leadership to the IEI and steered it through a difficult period for which, I, on behalf of all of us, express my profound thanks. Our past presidents have also been providing strong support and guidance and I am sure of receiving similar support.

India is poised to become an economic superpower in the coming years and in achieving this goal, the role of engineering professionals is highly crucial. It is heartening to note that India is producing more than a million engineering graduates in diverse disciplines through 4000+ Engineering Educational Institutions (EEI). Thousands of Polytechnic Colleges and Industrial Training Institutes are educating similar numbers / Diploma holders and skilled workers. While the issue of work-force numbers is being managed, quality is yet to attain the requisite standards to be counted amongst the best in the world. We should remember that we are producing professionals for getting employment anywhere in the world and also in emerging technology areas. Research and development base; innovation and patenting of research outcomes; commercialization of research results; and promoting entrepreneurs is not yet upto the expectations. When the country has the advantage of demographic dividend, education and skill development has to go hand in hand concurrently with employment generation.

We have to make the Indian engineering professionals pay attention to the matters of environment, employment generation, infrastructure creation; raising the living standards of the people; agriculture and food processing, affordable and accessible healthcare for billion+ population, communication and transport, energy and technologies for sustainable development. It should be the prime task of IEI to address these issues urgently. Also, technologies for disaster mitigation and realizing a civilian Early Warning System should be appropriately focused.

The 12th Five Year Plan unveiled recently with the prime theme, "Faster, Sustainable and more inclusive growth" focuses on poverty alleviation, assured and affordable healthcare, increased access to higher education and skill development, particularly, in respect of women and children and disadvantaged groups. IEI is in a position to leverage its pan-India presence across 106 centers to support the nation and society in achieving the goals and objectives of the 12th Plan. IEI should take the initiative to enhance skill development of the existing and new workforce entrants to drive employment generation, and ensure continued employability in the fast-changing technological scenario.

India is having maximum younger age representation of our population group and the labour force in India will increase by 22%. On the other hand, over the next 20 years, it will decline by 4 to 5% worldwide. The demography dividend can add to greater potential, if only higher level of health, education and skill development is achieved. This should be concurrent to the rapid economic growth, employment and livelihood opportunities. IEI has yeoman task for education and skill development of the existing and new work-force entrants to drive employment generation, and ensure continued employability in the fast-changing technological scenario.

Innovation, Research and Development

The high rates of economic and social development required in the process of India's march towards becoming a developed economy necessitates the strengthening of the role of engineering, technology and innovation in our society. This role comprises fundamental factors of a knowledge-led economy that are essential to face the challenges that lie ahead in a competitive global scenario.

IEI is committed to staying engaged with policy makers and the society to showcase how the deployment of new technologies contributes to economic development, quality of life, national security and health.

IEI's perspective is that incorporation of a cohesive and well contemplated national strategy for engineering, technology and innovation would support government policy making in multiple ways:

- A national strategy for technology and innovation would articulate the government's vision regarding the contribution of engineering, technology and innovation to India's social and economic development.

- A well-defined strategy sets priorities for public investment in engineering, technology and innovation, and identifies the focus of government reforms.
- Development of these strategies can engage stakeholders ranging from the research community, funding agencies, business, and civil society to central and state governments in policy-making and implementation.

Collaborative Academic Research

Contemporary research in many fields has increasingly become interdisciplinary and multi-disciplinary in nature with increased collaboration.

IEI's perspective is that research excellence can be achieved through a robust knowledge-management process and framework, collaboration with Universities and Research Organizations, and partnership with Industry. It is my view that IEI should focus on expanding partnership and collaboration in two areas:

- Motivate and incentivise academia, industrial and government researchers to develop new methodologies and identify new technologies.
- Work with the Central and State Governments to deploy cutting-edge methodologies and technologies that will empower them to effectively manage the natural resources and environment, to ensure long-term sustainability.

IEI through its peripheral fora, NDRF, is doing pioneering collaborative work nationally and internationally on Micro Air Vehicles, Sensors, Rapid Manufacturing, Mini Underwater Vehicles. It is high time; IEI should initiate “Internship Programmes” and Centre for Excellence in upcoming research areas. It is also the need of the hour to network with various Universities and leverage it and compliment the academic research programmes such as MS/M.Tech (By Research) and PhD.

IEI's research should be useful for the societal needs like Healthcare, Housing, Food, etc. To encourage younger engineers, IEI should strengthen the present IEI Grant-in-Aid initiatives.

IEI need to play an active role to encourage intellectual property for possible commercialization in the form of patents and royalties. IEI could establish a Centre at one of the Fora to deal with IPR and patent related initiatives.

Engineering Education and Skill Development

Higher Education plays a pivotal role in number of societal functions including development of human capital, building knowledge base, disseminating, deploying and maintaining knowledge and creating workforce. In this connection, I wish to recall the role of IEI which is contributing very heavily on engineering workforce by producing large number of qualified engineers for future jobs.

Globalisation of Engineering Education continues to expand. IEI has played its historical role in getting associated with Engineers' Mobility Forum (EMF) and Washington Accord.

IEI was the first accreditation body in India since 1935 and regulated the engineering programmes in our country.

In my view some of the areas, IEI could focus more on are:

- Accreditation: Introduction of contemporary courses to address current technology developments, and mutual recognition of these courses by foreign universities, and international professional organizations. This would promote acceptance by the Industry.
- Future of AMIE: AMIE has been a successful flag-ship program of the IEI. We should explore the possibility of introducing new inter-disciplinary courses. With the success story of AMIE

till date, IEI should explore the possibility and utility of establishing a new pan-India Technological University that would set benchmarks for technical and engineering education in the country.

- Creating future Green Jobs.
- Workforce Employability through National Skil development initiatives.

Leveraging Information Communication Technology (ICT)

India is doing a commendable job in the Innovation arena and has facilitated the Agricultural Revolution, White (Milk) Revolution, growth of IT Exports, Space Exploration, Atomic Energy, Defence, Pharmacy, Biotechnology, etc. IEI should explore the possibility of leveraging the success story in ICT to improve its relevance to the world economy by developing contemporary software products based on integration of knowledge and best practices from multiple disciplines. IEI should explore the feasibility of partnering new initiatives like the National Innovation Council, National Innovation Foundation, State Innovation Council/Centres, and National Knowledge Commission, to promote incorporation of best-practices from multiple technological disciplines.

Sustainability Engineering

I am of the opinion that IEI should take the initiative in promoting sustainability in a big way across the country, and should evolve a time-bound road-map for adoption of Green Technologies, establishing Green Campuses, Training/Retraining and Education for Greening of Industry.

IEI has to engage with sustainability issues that cannot be viewed only as an engineering problem. Sustainability has social, economic and cultural dimensions. Attitudes and education determine very much, how sustainability goals are achieved and how the economy and industry are greened. Greening again is not just a one dimensional environmental issue of meeting environmental targets but critically involves issues such as Quality of Growth and how we address and achieve inclusive growth.

Sustainability and Greening of Society and Economy is very important. Towards this, I see Engineers are having greater scope to play a major and critical role in making India a greener and more inclusive nation and society. This shift in the fundamental objectives of our educational, economic and industrial activities will ensure that not only will our future be sustainable but also secure for future generations who can be assured as a safe and livable future. To achieve these long-term goals we should aim to achieve our economic growth targets not just in terms of GDP growth but endow it with a “Quality of Growth” dimension also. Achieving Quality of Growth is likely to become the objective of nations and societies around the globe in the future. This becomes important in the context of worldwide efforts to address and avoid the calamitous future that awaits humanity as a result of Climate Change and Global Warming.

To show that we are serious and that we mean what we say in relation to sustainability, we will work with our IEI Centres across the country to make them sustainable in terms of critical resource use such as water and energy. These Centres will also become the flag bearers of sustainability practice and education by assisting them to shift to maximum utilization of renewable energy, adopt rainwater harvesting and water saving measures.

IEI Centres will also publicize these efforts to make both individual members of IEI but also others in society to adopt such practices and as a measure of their sensitivity to resource use and caring for the earth. We will plan to introduce programmes that will make all our IEI centres beacons of sustainable practice. We will work closely with our IEI Centres and help them partner with Ministry of New and Renewable Energy and other relevant Central and State

Ministries and agencies.

Greening of Campuses and Education for Sustainable Development (ESD)

The education of future engineers and shaping their attitudes and mindsets towards achieving sustainability is going to play an important role for the future of our nation. We have more than 4000+ engineering educational institutions' campuses across the country and thousands of engineers graduated out every year from these campuses. We can start a programme on the Greening of Campuses with target campuses to begin with by working closely with Ministry of Human Recourses Development and Ministry of Environment and Forest to define the objectives and achieve the goals.

We are also in the closing years of the United Nations Decade for Education for Sustainable Development (UNDESD) and which Decade will end in 2014. We need to see how Engineering Education can also closely align itself with the principles and goals of ESD.

Green Growth—Retraining and Education for Greening of Industry

As you all know, the greatest contribution of Engineers to society, to economic growth and to addressing goals of inclusion like employment is in relation to the contributions and roles they play in Industry. At the same time, you all know that even to be a good engineer in industry, engineers need to continuously update their knowledge, skills and keep up with contemporary developments in their disciplines and professions. More so with regard to achieving goals such as the Greening of Industry and which is part of the major goals of India's contributions to addressing the challenges of Climate Change.

India has a National Action Plan on Climate Change under which eight major national missions was announced. Our efforts to achieve the Greening of Industry will be closely aligned with the National Action Plan and efforts of United Nations' agencies such as UNEP, UN-ESCAP to achieve the Greening of Industry through programmes for education, retraining and skill building among engineers. These programmes will be to assist Engineers to develop innovative solutions towards the greening of industry and thus address the challenges of Climate Change. To do this I propose to work closely with Centres, Fora, through The Sustainability Platforms, with industry and UN agencies on creating education programmes, development of training modules for Engineers in Industry and Captains of Industry. These capacity — building programmes will cover areas such as ISO, Building Codes, Life Cycle Analysis, Sustainable Consumption and Production, Energy and Water Audits and Green Growth Indictors for Industry. My hope is that we can train at least 500 engineers every year in equipping engineering industry to shift to green and sustainable practices.

IEI Interface with Industry Bodies and Governmental Organisations

IEI should take the initiative to work with Industry Bodies and Governmental organizations and develop technological solutions that leverage the large communication network to ensure access to citizens' services, healthcare, banking in an affordable and easy-to-use manner.

Technology Intensive Industry—MSMEs

MSMEs are major and growing part of the global economy. IEI plays a significant role to strengthen Technology Intensive Industries to attract, cultivate and retain knowledge–technology-based industries and workforce to foster national prosperity and to increase national access to the global economy.

At IEI, we will need to prepare a plan to increase the relevance of MSME to help them scale-up, develop competencies and imbibe the best practices to work with global corporations, and deliver results in a cost-effective manner.

IENET, a Pan IEI Communication Network

I believe that we are in a situation where we need to get a data network connecting all IEI centres of the Institution. I believe this would help in greater coordination between various centres, chapters, foras and headquarters, provide facilities for remote working for IEI staff, both during travel and off office hours. This would also help share across the Institution best practices across centres, expensive software licenses and e-subscriptions, critical information through common database access, etc.

My vision for this would be a common facility that integrates better all the centres and other bodies of the institution, where information is shared, flagship lectures and programs are beamed across the centres for all members, lectures and instructions from Professors are shared across as a web service, more video and audio conferences between member technologists happen and a gateway is provided for other educational networks across the globe.

While these benefits are considerable, I believe such a network would provide a great platform for technologists associated with the Institution to think of new and more valuable initiatives and services that drive Engineering technology, by seamlessly utilizing the expertise across centres in real time. It also would be a great aid for people to exchange ideas and form interest groups across more easily for initiatives that can bring laurels to the institution.

Strength IEI Alumni

Alumni Associations across the globe have been pillars of strength for the parent institutions providing great networking opportunities, and supporting the institution in its initiatives. IEI is an institution with the largest number of Alumni in the country with over 3 lakh students. By sheer numbers, I believe this can be potent force that can catapult IEI to even greater heights. While not all are currently active, I know of many Alumni, who feel the need to reconnect to the Institution, not just as normal members, but with additional affinity one generally has for his own institution. I can visualize a vibrant alumnus group galvanizing the centenary celebrations of the Institution. I hereby make a very strong case to utilize our alumni more actively to drive the IEI initiatives.

Recognizing this dormant capability, The Institution took a first step with the first ever Alumni Meet during the IEC 2011, Bangalore. After the first meeting, I have heard of many valuable initiatives from the Alumni group. Those were all good initiatives and I see a need to have a greater coordination between IEI and the Alumni to take forward these activities to completion. I urge more volunteers from the Alumni to come forward and take these and other initiatives forward.

Empowerment of Women Engineers

I wish to have more involvement and active participation of women engineers in the coming years. In terms of enhancing the various women engineers' enrollment as corporate members in general and their active participation by having specific programmes to galvanize their mobilization under the banner of IEI in particular. All centres and foras of IEI can give special emphasis in this regard in coming years.

To conclude, I am of the opinion that IEI's focus on the areas discussed today will help India become a hub of innovation and usher in a knowledge economy. Let us make 21st Century India known for its engineering excellence and achievements.

Mr S S Rathore —a Brief Profile

Mr S S Rathore, FIE, has been elected President of The Institution of Engineers (India) for the Session 2012-13, at the 673rd Council Meeting of the Institution hosted by the West Bengal State Centre on September 29, 2012. Born on March 15, 1956, Mr Rathore obtained his Bachelor's Degree in Civil Engineering from L D College of Engineering, Ahmedabad, topping Gujarat University in the year 1978 with Gold Medal. He appeared in the Gujarat Public Service Commission Examination, topping the merit list and was appointed as Executive Engineer in the State Roads & Building Department in 1980. Since then, he has worked in various capacities like Executive Engineer, Superintending Engineer and Chief Engineer. He was promoted as Secretary to Government of Gujarat in 1997 at the age of forty- one and became Principal Secretary in the year 2006.

Mr Rathore served as the Chairman of the Gujarat State Centre of the Institution for the period 2004-2006 and has been a Member of IEI Council since 2004. He was also the Chairman of Water Management Forum of the Institution during 2008-2011.

He was elected Vice President of the Indian Roads Congress in 2000 and became the President in 2003. The Ministry of Rural Development extensively utilized his vast experience and knowledge in formulation of Rural Roads Manual and other aspects of the Pradhan Mantri Gram Sadak Yojana. He successfully organized the Indian Roads Congress Annual Session at Ahmedabad in 2004. He has to his credit many papers on Roads, Environment, Green Highways, etc. Mr Rathore has also travelled widely across the globe on various government assignments.

Mr Rathore has pioneered long distance PPP projects on State Highways, including the first long distance four laning projects in the country, namely the Ahmedabad-Mehsana and Vadodara-Halol projects. Major projects undertaken by Mr Rathore included the World Bank assisted Gujarat State Highway Project, the World Bank and Asian Development Bank assisted Gujarat Emergency Earthquake Rehabilitation Project, widening of around 3000 km of State Highways to two-lane with paved shoulders (10 m), construction of Mahi, Narmada and other bridges on BOT, 1st Cable Stayed Bridge in Gujarat at Bhavnagar, Pradhan Mantri Gram Sadak Yojana and NABARD assisted Rural Roads besides projects of various prestigious Government Buildings, Air strips, etc. He was instrumental in completion of the Rs.180 crore Mahatma Mandir (Convention Centre) at Gandhinagar, in a record time of 182 days. He successfully initiated and completed the World Bank assisted Gujarat State Highways Project-I, rated by the Bank as highly satisfactory and the most successful externally aided Road Project in the country. With this project, he initiated and undertook major reforms in the Highway Sector which was appreciated by the World Bank.

Amongst the present projects under implementation are the nearly completed LEEDS UK Gold rated Green Building of Jilla Seva Sadan (housing all government offices and residences at Vyara), six laning of Bagodara-Vasad under BOT with GVK, the Gujarat State Highway Project-II envisaging amongst other roads a model Green Highway and a Model Safe Highway and various other projects.

The Ministry of Road Transport & Highways, Government of India, appointed Mr Rathore as a Chairman of Sub-Group on State Roads for Formulation of 11th Plan in 2006. He was appointed Chairman of the Sub-Group for the 12th Plan also. He was Principal Secretary of the Narmada, Water Resources, Water Supply and Kalpsar Department from 2006 to 2009, where he successfully completed the Sujalam Sufalam Yojana for drought prone districts and efficiently handled severe floods of 2006.

Presently working as Principal Secretary to the Government of Gujarat, Roads and Buildings Department, his field of work includes construction and maintenance of the more than 1 lakh km of road network in the state of Gujarat and important Government buildings. His work entails frequent interaction with Government of India as he also handles all Central Government subjects like Expressway and National Highways, Railways, construction of Airstrips, Post and Telegraphs, etc.

Mr Rathore is the Chairman of the Gujarat Road and Infrastructure Company Limited and Director in Gujarat Industrial Development Corporation, Gujarat State Road Development Corporation, Gujarat Tourism Corporation and Gujarat Water Infrastructure Limited.

Mr S S Rathore will assume office as the President at the Ninety-third Annual General Meeting of the Institution scheduled to be held at New Delhi on December 16, 2012.

Mr Ashok Kumar Basa

President 2013-14

Presidential Address

It is with great pleasure and honour, I welcome you all to the AGM of the Institution of Engineers (India) being hosted by Tamilnadu State Centre at Chennai. I am indebted to the galaxy of revered Past Presidents for their gracious presence. I am also thankful to the Council Members and other Corporate Members for sparing their valuable time in attending this AGM. I feel privileged to stand before you this afternoon as President of this esteemed Institution for the next term. I am grateful to the Council for having bestowed upon me the opportunity for serving the Institution in this prestigious position, being fully aware of the great responsibilities which go along with this high office. I pray the Almighty to bless me to make efforts, to the best of my capabilities by the wisdom and guidance of the Council to keep up the standards set by the illustrious Past Presidents, some whom are amidst us today. However, I feel it appropriate to remember on this occasion the doyens of engineering profession who, with self-less dedication and commitment, contributed to the development of engineering and the country for its progress and prosperity. Bharat Ratna Sir Mokshagundam Visvesvaraya, Sri R N Mookerjee, Dr A N Khosla, Dr Triguna Sen, Padma Bhusan Dr K L Rao, Nawab Zain Yar Jung Bahadur, Er Dildar Hussain, Dr M S Thacker and many other illustrious engineering personalities, who were also at the helm of affairs ofthis august Institution and responsible for its growth in all directions with their devotion, dedication and leadership.

The status of engineering profession in India became a matter of higher importance during 1916-18 and it received due public prominence in the Report of the Industrial Commission. There were endeavours to advance an industrial society to safeguard and assure the status of the profession. Sustained efforts by a group of Indian and British Engineers brought "The Institution of Engineers (India)" into its rightful place and the Institution was registered on September 13, 1920 under the Companies Act of 1913 with Madras as the "Province of Registration". The Registered Office was shifted to Calcutta on November 11, 1920. In recognition of valuable services for the cause of advancing the engineering developments, the Institution was granted the Royal Charter in 1935. With this modest initiation, this great Institution has been progressing well and is engaged in multifarious developments towards the growth of engineering profession in the country. As of date, there are 104 State and Local Centres with a membership strength of nearly 0.7 million. We have five Overseas Chapters and bilateral relationships with thirty one sister professional societies of international repute. Fifteen engineering disciplines in addition to one "Interdisciplinary Co-ordination Committee" have been conducting various technical discourses throughout the country with a strong zeal to enrich technical knowledge of our members in particular and the entire engineering community in general in order to transform the society into a knowledge-based one. This endeavour would surely help India to mitigate the damage posed by any sort of natural calamity and also upgrade the quality of life of common people through mission oriented tasks.

The Institution has also established five autonomous for a and an autonomous organ for meeting the challenges related with specific areas for national interest. Of these the Engineering Staff College of India (ESCI) organizes various technical training courses throughout the country to upgrade the technical knowledge of practicing engineers and technologists. It conducts continued education courses to upgrade and update the technical and professional knowledge of the practicing engineers. National Design and Research Forum (NDRF) disseminates the desired information in all matters related to engineering design and research and propagates the indigenous concepts emerging from the relevant priority areas in the field of engineering. Rural Development Forum (RDF) has its prime objective of upgrading the quality of life of the rural poor by absorption of the outcome of scientific developments coupled with appropriate and low-cost technologies operable with locally available resources. Water Management Forum(WMF) offers technical expertise for conserving water resources and also implementing water management techniques, so as to ensure optimal use of water while maintaining water quality. Sustainable Development Forum (SDF) propagates the message of sustainability in engineering and related development. Safety and Quality Forum (SQF) was established with the main objectives of promoting safety and quality awareness in engineering operations.

The Institution is pioneer in the field of specially-designed engineering education in the country. During 1928, when the infrastructure of Indian Education was inadequate, the Institution in its wisdom coupled with a visionary view, started conducting Sections A and B Examinations in engineering disciplines with only four candidates. With the passage of time, the strength has increased manifold and at present, nearly 60000 aspirants each year appear in the examinations. This examination is considered to be the oldest, yet engineering examination in the country and the pass-out candidates have high degree of acceptance by industry and academic institutions both in India and abroad. I consider this endeavour of the Institution as a National pride since we are adding nearly 2000 professionals each year. This course is attracted especially by those who are in the profession at lower tier as technicians and diploma holders. Compared to formal education in engineering, this mode is more economical and, therefore, the weaker section of the society can afford the cost of this education system that is recognized by the Ministry of Human Resources Development, Government of India. The pass-out students are considered as equivalent to engineers graduating from National Institutes and Universities.

The Institution of Engineers (India) has been playing a leading role at the international level towards shaping the noble profession of engineering to cater for the vital needs of the world of 21st century and transforming our society into knowledge based society. Besides having five

Overseas Chapters and bilateral relationship with thirty one sister professional societies of international repute in different countries across the world, IEI is a member of various international bodies including the World Federation of Engineering Organizations (WFEO), Federation Internationale du Beton (fib) and Federation of Engineering Institutions of South and Central Asia (FEISCA), Federation of Engineering Institutions of Asia and Pacific (FEIAP).

In a landmark achievement, The Institution of Engineers (India) (IEI) obtained the full membership with interim authorization of the International Professional Engineers Agreement (IPEA) for India at the Bi-annual International Engineers Meetings 2009 held at Kyoto, Japan on 17 June 2009. The International Professional Engineers Agreement(IPEA) is an International Recognition Agreement for Professional Engineers among the engineering organizations in the member jurisdictions, which creates the framework for the establishment of an international standard of competence for professional engineering, and then empowers each member organization to establish a section of the International Professional Engineers (IntPE) Register.

Simultaneously IEI also provides thrust on R&D activities by its members associated with different engineering institutes and also by the students of those institutes by providing appropriate financial support and infrastructure support. That ensured IEI's recognition as an R&D institution of national importance. The present approach of funding projects at undergraduate and post graduate levels is basically similar to the national programmes on awareness and enhancing mindset of young engineers for R&D. R&D Centres of IEI are also being set-up at different state centres.

The biggest challenge today before the engineers is to see how best development can take place with the least amount of negative impact on the environment creating environment friendly, ecologically appropriate, energy saving and sustainable developmental options sustainable not only for the present generation but also to the emerging future generations. I would like to highlight two major issues, which are essential for sustainable development. IEI can play major role in these areas because of its presence in almost all the states of the country.

Disaster-Mitigation Engineering

“The Indian Sub-continent having its 59% land vulnerable to earthquake, 8.5% land to cyclone and storm surges and 5% of land to floods is considered as one of the world's most vulnerable to disaster.” 1999 Odisha Super-cyclone, 2001 Gujrat Earthquake, 2004 Indian Ocean Tsunami are some important examples of natural disaster of recent past.

The year 2013 also saw one of the worst disasters in Uttarakhand in India in the form of cloudbursts, flash floods and landslides and the loss of lives. Gradual loss of green cover by virtue of excessive interference with ecology in the form of construction activity, denudation of forests as well as traffic in the hilly areas has triggered the situation and that the situation was further aggravated by two huge downpours of water and rocks from the high mountains, in all probability caused by glacier lake outburst floods (GLOFs), which deluged Kedarnath. GLOFs, or the explosive bursting of glacier lakes, are a consequence of climate change, which is causing rapid glacier melting in the Himalayas. The unusual heat generated by construction and motor vehicle emission resulted in localized cloud cycles and cloud bursts. Earlier, these cloud bursts were not so frequent as thick green vegetation present buffered the situation. The natural calamity which struck the state recently could not have been prevented but the massive scale of devastation caused by it across the state could perhaps have been minimized if an early warning system, effective evacuation plans, and a responsive disaster management system were more effective.

Natural disasters result in crippling economic losses and human tragedy, hampering development wherever and whenever they occur. Due to recent rapid urbanization in developing countries, many people reside in buildings and areas that are vulnerable to natural disasters. Disasters that strike in developing countries can severely impair efforts to alleviate poverty. In order to reduce the effects of natural disasters, and human losses in particular, the approach towards disaster management is to be shifted from post-disaster reactive approach to a pre-disaster proactive approach, from response to preparedness and long terms mitigation & prevention. Time has come that disaster management should not only be confined to 3R known as Relief, Restoration & Rehabilitation, but also should include 3P known as Planning, Preparedness & Prevention. To meet this need, disaster management experts must be cultivated through professional education and training, so that they may develop and apply tailor-made disaster management policies and techniques attuned to local conditions.

Addressing Disaster Risk is a very important element in disaster management. Any development in eco-fragile zones has to be carried out very carefully with disaster risk management efforts and such efforts must get defined through comprehensive analysis of the ecology of the area, people and their culture, tradition and coping capacity etc. The Disaster Risk Management Programs must get designed through a bottom up participatory and consultative process; the technologists as well local society should work synergistically in such exercises.

Disaster Risk Reduction through Engineering Applications or Disaster Mitigation Engineering focused at designing, building and retrofitting civil infrastructures that is capable of resisting and mitigating effects of disasters should be taken-up with all seriousness. Primary focus of Disaster Mitigation Engineering would be designing, construction and retrofitting of buildings, bridges, communication networks and irrigation systems against most frequently occurring disasters which include earthquakes, floods and landslides.

Fundamentals of Disaster Risk Management, Structural Analysis, Geotechnical Engineering, Foundation Engineering, Landslide Analysis and Prevention, Disaster Mapping through GIS and Remote Sensing, Climate Forecasting, Early Warning System, Evaluation and Retrofitting of Civil Structures, Flood Hazard Modeling and Flood Forecasting, Forest Fire Forecasting and Mitigation, Glacial Lake Monitoring and Preventing GLOF, Watershed Development through Scientific Processes would be some of the key elements of Disaster Mitigation Engineering.

Disasters are a natural phenomenon, which have been occurring throughout the history of mankind. But the frequency and spread of their occurrence in last two decades due to climate change and unplanned developments in disaster-prone areas have increased manifold. Stopping development is not the answer. What is needed is careful planning and compliance with geographical and ecological demands: science, patience and coordination instead of greed, haste and administrative lacunae. The Institution of Engineers (India) being the harbinger of Engineering Education and Research in the country had already taken a conscious and concerted effort in this direction. Most of our centres, especially those located in the disaster prone zones have put forth praiseworthy efforts in organizing technical activities periodically aimed at creating awareness and ensuring our preparedness to mitigate such disasters which have been crippling our nation from time to time.

Skill Development in Engineering and Technical Fields

Knowledge and skills are the driving forces for progress and development of a country. Planning Commission, Government of India has documented that demographic advantage can be derived by the country by working on Skill Development. But we cannot escape the truth that the Nation as a whole and the Society suffers, more often than not, on account of poor productivity and bad quality of workmen and supervisors. Engineers as they develop in their career are elevated to the status of Managers. They are spending more often, major part of their time and energy in paper work which though important, also could give better results, if properly oriented, in the direction of generating capable trained personnel for field work. Promoting lifelong learning for all is the paramount need of the hour.

Recognizing that the young population in the employment market needs to be trained, National Skill Development Initiative (NSDI) scheme was launched on the 22nd May 2007 by Government of India with outlay of Rs.1000 crore (additionally Rs.15000 crore by the States). It was decided that NSDI would empower all individuals through improved skills, knowledge, nationally and internationally recognized qualifications to gain access to decent employment and ensure India's competitiveness in the global market.

The Nation's labour force today is 26 million in organized sector and 433 million (93%) in the unorganized sector; producing 60% of the GDP. While about 5 million enter the labour market every year, only about 3 million Vocational Training seats are available with some doubts on quality of outcomes. In Construction Sector, only 2% have specialized skills. The target is to impart quality training to 500 mn by year 2022 by attracting investment in skill development. The task is to increase and add capacity, capability and raising qualitative standards of the training centres to achieve right outcomes.

Government and Private Sector convergence is needed to ensure involvement of all Stake holders. Institutional mechanism of R&D, Quality Assurance, examinations and certifications are needed. The necessity of these institutional mechanisms has been recognized by the Government of India. Skill frame work should move to a system of equivalence to diplomas and degrees. Role of State and Centre, Government bodies have been defined. Upgradation of T&P and learning aids are a part of Skill Development activity. Rural, hilly areas and border areas reach through mobile units. Entry level barriers such as educational qualification, transportation, loss of wages, languages etc. are being addressed. Besides vocational skills, the provision for soft skills is also necessary. Women participation is being raised to 30%. Reservations applicable to SCs, STs, OBCs, minorities, disabled are to be considered for Skill Development activity.

The Institution of Engineers (India) should propagate for Skill Development through it's different centers. To start with, it should coordinate, cooperate and work, in close coordination with Government agencies and industry. The Institution of Engineers (India) has been working so far for engineering professionals. By including Skill Development in its scope of activities, the complete scenario shall change. It is necessary to frame the total programme of activities, so that change process is gradual and it becomes acceptable by different units.

Time has come for us in the IEI to involve ourselves in the activities by which our presence can be felt not only in engineering profession alone, but also be beneficial to the society as a whole. I have only mentioned two such areas, which may help us to move in that direction, as a beginning.

“National economic development is powered by competition. Competition is powered by knowledge. Knowledge is powered by technology and innovation.” So said Dr. Kalam our former President. Thus we engineers should not merely be content in contributing to technology but also we should try our best to combine innovation with technology to have value-addition which ultimately will help us to achieve the required national economic development.

I wish each of you, & the members of our engineering fraternity including their family & friends for a happy, healthy & prosperous new year 2014. In fine I request all of you to join with me for a prayer to the Almighty —

“God grant me
the serenity to accept things I can not change,
the courage to change things I can,
and the wisdom to know the difference between them”.

Mr Ashok Kumar Basa —a Brief Profile

Mr Ashok Kumar Basa (born in 1958) has topped in Civil Engineering from Regional Engineering College (presently known as National Institute of Technology), Rourkela, in 1980. He also won the Best All Rounder Gold Medal of the college in the same year. After graduation, Mr Basa worked as an Assistant Engineer in Odisha PWD for a brief period. Being successful in the Combined Engineering Services Exam held in 1981, he was also selected for a Govt. of India job as his rank was high in the merit list. He did not join the same. In 1982, he joined B Engineers & Builders Limited, a construction and design company, as Director (Technical). Presently, he is Managing Director of a consultancy firm, CEM Engineers & Consultants (P) Limited based at Bhubaneswar.

Mr Basa got an opportunity to design and construct the 1.8 km long flyover, the longest of its kind within the state near Cuttack Railway Station. With such a startling beginning, Mr Basa, as Director Technical of the Company, was involved in almost all the important works of the company. Some important projects executed are Indoor Stadium at Cuttack, 2 km long Pre-stressed Concrete Girder Bridge in Mahanadi Barrage near Cuttack, one of the longest bridges in Jharkhand across River Sakri, one of the longest Pedestrian Suspension Bridges across river Mahanadi near Dhabaleswar, 1.4 km long Railway Bridge across river Brahmani, etc. He was involved in the design and strengthening of a bridge (Lilari) on which exceptional load of 200t could be passed over successfully.

He had a flair for writing technical papers and till date about fifteen papers have been published in different national and international journals including Indian Roads Congress, Indian National Group of International Association for Bridge & Structural Engineering (ING-IABSE) etc. He has also been appointed as a reviewer by Indian Roads Congress for a number of years. Mr Basa was co-editor of a book 'Rehabilitation & Retrofitting of Structure' brought out by The Institution of Engineers (India) and published by MacMillan.

Winner of several awards, such as, Young Meritorious Engineering Award, Er S V Srinivasan Gold Medal of Odisha Engineering Congress, Gold Medal by the Odisha State Centre of The Institution of Engineers (India), Mr Basa was awarded with the prestigious Indian Roads Congress (IRC) Medal for Best Paper in Construction in 2007. Earlier, in 1998, he also received the IRC Medal along with his colleague for his exemplary work in Brahmani Railway Bridge near Jenapur. He also received the prestigious Confederation of British Industry (CBI) Scholarship in 1990.

Mr Basa is a well known figure in the country as a structural engineer. Because of his notable achievements in design and construction of bridges, Mr Basa has been nominated by Indian Roads Congress as a member and inducted into different committees, such as, Foundation Engineering Committee, Prestressed, Reinforced & Composite Concrete Committee, Committee for Maintenance & Rehabilitation of Bridges, Flyover & Elevated Structures Committee, Steel & Composite Structures Committee etc. He has also been the member of prestigious Bridge Specification & Standards Committee since 2003.

Mr Basa is an active member of the Institution. He was the Honorary Secretary and Chairman of the Odisha State Centre of IEI in the session 2000-2002 and 2002-2004, respectively, and during his tenure as Chairman, the State Centre was adjudged Best Centre in 2003 by IEI. He was elected to the Council of the Institution representing the State of Odisha since 2004. He has been a member of various committees of IEI, such as, RCC, ICC, AITC, LBC, CATE, IMC-fib, IMC-WFEO, BYC, SPC, etc. He also worked in the Board of Governors of different Fora such as SDF, WMF, SQF. He has been the member of the Finance Committee for five times and Chairman, Civil Engineering Division Board for three times (2007, 2011, 2012), Chairman of SHMC (2010) and Chairman of EISC (2004).

As regards his international presence, Mr Basa is a member of the Disaster Risk Management Committee of World Federation of Engineering Organization (WFEO). He presented a paper in Disaster Risk Management Pannel Session of WFEO in September 2011 in Geneva. In World Engineering Forum (WEF) 2012 in Slovenia, he was nominated as a 'Speaker' by WEF in which he highlighted India's emphasis on Disaster Management in developing Indian Tsunami Early Warning System (ITEWS) for prediction of Tsunami in Indian Ocean.

Thus Mr Basa is not only active in his professional field, but also believes in serving his fraternity for an inclusive growth & development of the nation.

Dr L V Muralikrishna Reddy

PhD, FIE, IntPE, FIET (UK), CEng (UK)

President 2014-15

Presidential Address

Dear Members,

It is my great pleasure and honour to stand before you and greet you all at the Annual General Meeting of The Institution of Engineers (India).

I am overwhelmed by the participation of the large number of Council and Corporate members of IEI, including the galaxy of Past Presidents, and am grateful for your gracious presence. I feel truly privileged to be here as the President of this esteemed Institution and to serve the engineering community. With your wholehearted support, I am confident that we can lead The Institution to scale new heights.

I would also like to congratulate the Andhra Pradesh State Centre for organizing this AGM and the 29th Indian Engineering Congress in an exemplary manner.

I would like to express my gratitude to the Council for electing me as President and giving me an opportunity to serve IEI; Karnataka State Centre from where I started learning the IEI System and received continuous inspiration to pursue leadership opportunities; and NDRF which has been the corner-stone of my professional growth, attainments, and provided significant avenues to learn and implement challenging tasks. I acknowledge my success to Office-bearers of the Committees; and Staff of the Headquarters, KSC and NDRF for their constant support and encouragement. I seek the blessings and best-wishes of all those who have supported and guided me in this journey. I also appreciate the wisdom and direction of the Council for furthering the high standards set by the Council and our illustrious Past Presidents for the last

95 years.

I am taking over from Er. Ashok Kumar Basa, who has provided strong and effective leadership to the IEI, and steered it through a period of rapid transformation, for which I express my profound appreciation.

As a diverse group of professionals, IEI has been able to integrate multiple problem-solving approaches to achieve the common goal of serving the Indian Engineering Profession. I believe that by effectively working with all IEI well-wishers, we can address the growing needs of the Members, transform IEI, and accomplish the core IEI Mission.

I would like to share my thoughts and also propose various future plans on this august occasion, while continuing with the good work done by IEI.

Global Megatrends and Engineering Attainments

Globalization is metamorphosing the location of manufacturing and services and the current wave of globalization has resulted in the tectonic power shift to BRICS nations of which India is a member. Engineering is the foundation for the twenty-first century global economy, and is the pathway to address societal challenges. For India to progress in the global economy, it is essential to invigorate engineering education and make it more attractive to young Indians.

The "Zero Draft" on '17' Sustainable Development Goals that will perhaps succeed the United Nations' Millennium Development Goals includes promoting healthy lives, bio-diversity, ending poverty, reducing inequality, promoting sustainable energy, and tackling climate change, amongst others, as themes the world need to focus on to eradicate poverty and multiple deprivations.

To achieve these societal needs, it is essential for contemporary engineers to focus on technologies that will improve production, storage and processing of food; enhance water distribution and waste management; strengthen education and healthcare; implement sustainable development; refine weather prediction; and deploy energy conservation methods, amongst others.

Engineering, Technology, and Innovation in India

India's growing middle class population demands new products, systems, solutions, and services at affordable price points. This requires innovation fuelled by technological and engineering excellence.

The Government of India has announced several programmes for the inclusive economic growth and improvement of the quality of life of its citizens. The engineering fraternity needs to take note that all the major initiatives including "Come, Make in India", Digital India, Establishing World Class Infrastructure, 100 Smart Cities, Metro Projects for 50 Cities, Modern Waste Management Systems for 500 Cities, Affordable Healthcare, Swachh Bharat, Sanitation for All, Clean Energy, Water Conservation, Clean Ganga Programme, and Skills India present substantial opportunities for Indian engineers to contribute to the accelerated national development and overall growth of the engineering profession.

Reinventing the Indian Engineering Brand "The IEI"

The World Economic Forum's Global Competitiveness Index notes that India is in the top tier with respect to availability of engineers and scientists. While the world recognizes and honors, individual contributions of Indian engineers to the development of the economy and inclusive growth, "Indian Engineering" has not got the recognition it deserves. The need of the hour is to transform the way Indian engineers are looked at. I believe IEI is the right platform to address this, and it will be my endeavor to transform the way Indian Engineering is looked at, and help it get the recognition it deserves. I intend to introduce the following measures to herald the makeover of Indian Engineering through lEI:

- Interface with Government Policy-makers

We live in a world shaped by Engineering. Engineering and Technology solutions are the vehicles by which government policy is delivered to societies, and it is essential that the inputs on the engineering perspective are presented to decisionmakers as an essential element of the legislation making process. It is imperative that the Engineering fraternity in India makes a concerted effort to sensitize the Government on the need to include engineers in the policy-making process. I seek inputs of the esteemed members to develop an effective engagement model with the Government and incorporate in the implementation process.

It will be my endeavour to build a healthy synergy between the Governments and The IEI across the lifecycle encompassing programme planning, implementation, and monitoring. I envisage IEI's participation to be at three levels in the planning process sector-wise, program-based, and project-specific. The outcomes of deliberations of Division-wide programmes would be effectively shared with the Government and Industry to facilitate sector-wide transformations or improvements. This engagement with the Government will be one of the steps to help re-establish the pristine position of The IEI.

- Deepening Engagement with Academia and Industry

The rapid pace of technological obsolescence makes it imperative for the current and future generations of Indian workforce to remain abreast of the changing paradigm. This can be achieved through IEI's Continuing Education Programmes. The objective of this initiative is to offer professional or domain-specific intensive training for human resources development. State-of-the-art technology, equipment, content development, and delivery methods will be adopted to ensure that these programmes are best-in-class.

A Standardized Certification System to check the competency and technical proficiency of the workforce is essential. This centralized system will help organizations to save recruitment and training efforts; and will boost the recognition of certifications. IEI is in a strong position to offer such services that would find acceptance with Public Sector Enterprises, Large Industry, and Micro, Small and Medium Enterprises.

IEI will use the partnerships with Academia to establish Innovation Cells and develop the curriculum to enlighten the students about the requirements of society and industry, and will apprise them about the challenges and rewards associated with pursuing entrepreneurship through start-ups.

IEI should effectively use its outreach programme to promote engineering R&D to effectively engage with the Public Sector Enterprises to strengthen the R&D initiatives undertaken by adopting an interdisciplinary approach.

The Intellectual Property and Patents cell of IEI should conceptualize and drive various programmes to forge convergence of interest in applied engineering research by both academia and industry, with the objective of patenting technologies to protect IP that can also improve the quality and reliability of the industry's products, drive down costs, and enhance profitability.

- Capacity Building and Internationalization of IEI

IEI as the largest professional body of engineers in India and with its presence across engineering disciplines should be the ideal face of engineering development in India. I will be making concerted efforts to help IEI to gain universal acceptability in the international technological, economic, and social arenas; forge Partnerships with International Bodies including UN, UNESCO, WTO, World Bank and ADB; and enhance existing alliances with all partnering international organizations to a greater level.

Synergy with International Organizations will help to stimulate job creation through enterprise building; facilitate development of career advancement paths to inspire present and future generations of engineers; and eventually create the International Brand for The IEI.

The global thrust on Sustainability has brought to fore the need for new skills and has created new job avenues that are in line with the Nations' steps to protect ecosystems and bio-diversity, de-carbonize the economy, reduce energy, materials, and water consumption, amongst others. IEI is in a position to support this global initiative of creating "Green Jobs" by offering effective and affordable training and certification.

- Mobility of the Engineering Profession

Globalization has demonstrated that jobs can be moved from one country to another, and has emphasized the need to build competencies relevant to the changing scenarios. For this, I propose that we extract the maximum benefit from:

⊙ Washington Accord which is a Game Changer for Indian Engineering: IEI has played a significant role to obtain full membership for India. This will help India to become a global provider of trained engineering workforce with the necessary skills and competencies. IEI will continue to work with the current accreditation providers, and pursue our accreditation programmes and steps to strengthen it with the objective of building an efficient and strong global accreditation system in India.

⊙ International Professional Engineers Agreement (IPEA): I propose to utilize IEI's permanent membership with IPEA to benchmark our engineering education practices vis-a-vis the global benchmarks, and facilitate engineers to seamlessly integrate into the world economy, thereby flourish as world-class engineering professionals

Transforming the IEI Education System

The IEI Education System has been proven and tested in the global workforce productivity arena and has significantly contributed to the national development activity. I feel IEI should adopt contemporary technologies to continue to provide world class education and continually innovate to remain relevant. In this regard, I wish to share the following:

- Vision of Indian Engineering

Contemporary Engineering has taken on the development of systems of mammoth scale and increasing complexity. These systems have to integrate societal considerations during the design, development, and engineering processes. It is, therefore, essential to adopt a systems perspective. In the coming years, Engineering will no longer be individual discipline-based, but will require combination of multiple disciplines to solve global problems. I therefore, propose that Indian engineering ethos should be built around Interdisciplinary Engineering and Systems Engineering principles. To do that, each of our 15 disciplines should interact and connect in a cross-linking manner to give new dimensions to engineering challenges. Attempts should be made to resolve challenges at one go in a comprehensive manner by introducing and initiating new educational programmes and examinations.

- Centering AMIE Education in Engineering Practice

The continuous upgradation of the AMIE program is being pursued to remain on par with other examination systems and ensure increased employability for students, thereby increasing acceptability with Government and employers. Many of the IEI stalwarts are leading practitioners of engineering in the industry, academy and policy making. I look to their valuable inputs to strengthen the AMIE programme, including curriculum, acceptability, recognition, planning, and so on. To protect the 90+ years, well-structured, tested, established, and perfectly branded AMIE system from critics and current crises with the evolving regulatory mechanism, I promise my whole-time and effort through intelligent resolving approaches to maintain the dignity of the recognition and acceptability of the AMIE programme credentials.

- Accreditation and Quality Improvement

It is needless to reiterate that IEI is the first and oldest Accreditation Body in the country for engineering programmes and has continued the task of providing quality benchmarking in engineering education. Outcome-based education is the future of accreditation standards. In the context of the National Accreditation Regulatory scenario, I propose that IEI will need to put together its vast, combined experience to develop an effective IEI Accreditation and Assessment System that is globally aligned and on par with internationally recognized accreditators.

- A University: Pathfinder

IEI is contemplating to establish a University to progress its educational activities to cater to the needs of the aspirations of the engineering profession. IEI members, alumni, current and future students will immensely benefits through this proposed University Model that will address the specific requirements of our members and that of IEI's new Education initiatives. My dream of the "University" is one that sets objectives, competitive cost advantage, attracts the top-notch human talent to work with stellar faculty, deploys multifarious delivery modes, and develops cutting-edge education and multi-discipline research outputs. I visualize a scenario where the present IEI Education delivery options are progressed quickly to the University Mode to make it a reality at the earliest.

- Engineering Skill Development: Global Requirement

I propose that IEI should participate in the mammoth national skill development initiative "Skills India" aligned with the National Vocational Education Framework at two levels: IEI should collaborate with Central and State Governments by focusing on developing quality content, and training standards to deliver to the needy, and IEI should engage with the industry by establishing knowledge partnerships and alliances with the industry for continuous industrial needs. I propose that each State/Local Centre should establish an Innovation Centre focusing on skills in contemporary technologies to address the regional and national demand. I compliment NDRF, ESCI, SQF and other centers that have conceptualized and coming forward to establish contemporary Innovation Centres to address the requirements of the country's skill development.

- "Contributor Engineer" Module

A "Contributor Engineer" is an enabler and delivers maximum output to the given assignment/task with sincerity, in an ethical manner, and invests time for real improvement and growth of the profession. India is producing lakhs of engineers to join the global engineering community but with least "Contributor" life skills.

IEI being one of the largest providers of education in the country should offer specially designated "Contributor Engineer" programmes for the entire gamut of Engineering Education Programmes. I feel we are strategically positioned to do this at a pan-India level through our Organs, Fora, and Centres. This programme is also envisaged for current and prospective AMIE students. By doing this, IEI will become the game changer in Indian Engineering Education System by equipping students with contemporary technology competencies and equipping them with life skills.

Promote Research and Innovation

Innovation is the precursor to competitiveness and growth. It is also believed that the nation's ranking in innovation is linked to the investments in Research and Development. It is essential for IEI to build an alignment of engineering with R&D as per the international requirements. I propose the following initiatives to strengthen IEI's case for recognition and status as a major player in the promotion of R&D in the country:

- Collaborative Research, Innovation and Patents

Engineering research requires integration and synthesis of concepts across related disciplines, and collaboration between academia, industry and national research laboratories. To ensure that the industry participates and contributes to the R&D efforts, IEI should establish focused

R&D Labs in different geographies. It is imperative that IEI initiates "Internship Programmes" and promotes establishment of "Innovation Centres". To encourage younger engineers, IEI should strengthen and re-orient the present IEI Grant-in-Aid programme.

IEI has initiated steps to protect intellectual property and to pursue commercialization of research results through IEI's Intellectual Property and Patents Cells. I am pleased to note their initial successes at NDRF.

- Science, Technology and Innovation Policy Research Centre

While India has a number of centres carrying out research at the interfaces of technology, environment, and policy, there is a dearth of "actionable" scientific information that can be used to understand the choices available to society in crucial areas such as climate change, ecosystem management, science investments, and carbon management, amongst others. I see this as an opportunity for IEI to establish a vibrant and active Science, Technology and Innovation Policy Research Centre that integrates interdisciplinary Science, Engineering and Technology Research with the needs of policy-makers, so that the research community can sharpen its focus on areas of societal importance; and policy-makers can integrate science and technology advances in their policy-making process.

To realize this, IEI should initiate dialogue with government, industry and international bodies to receive financial and resource funding.

- Make in India, MSME, and Incubation

The need to raise the global competitiveness of the Indian manufacturing sector is essential for the country's long-term growth. Each division of IEI will be encouraged to organize activities and workshops to ascertain the manufacturing potential, requirements, capabilities, deficiencies, innovation, and the Government support required to contribute to the "Come, Make in' India" program. The inputs from all these divisions will be collated to benchmark our manufacturing capabilities with global standards and identify the areas where the policy will need to be strengthened to ensure a successful implementation in a priority development area. This is an opportunity for IEI to work closely with the Governments and industry to strengthen the relations, and build capacity.

I feel that IEI should utilize and integrate the deep domain expertise available in various engineering disciplines. In addition, we should encourage the entrepreneurial zeal of AMIEns and early-stage technology innovation, design and research spinoffs from collaborative R&D programs to incubate new technologies in the ever-expanding MSME sector, which is the backbone of India's GDP growth.

Strengthening "The IEI”

In addition to working on interventions to transform the engineering ecosystem in India, and building global partnerships, it is essential to take certain concrete steps; I intend to strengthen our Institution by:

- Creating a "Performance Culture" in The IEI

Performance culture is a system that requires a systematic approach to managing the performance of organizations, teams and individuals. It is essential to introduce a "Performance Culture" amongst the IEI Systems including the workforce available at our Institution with the objective of resolving members' needs, delivering solutions, and pursuing new engineering challenges. This is the only way we can serve the entire engineering community for which IEI is striving

- Capacity Building of Centres

The State/Local centres are the backbone and nerve-systems of the IEI organization. They facilitate the last-mile connectivity between the IEI headquarters and the large member base.

Apart from regular engineering activities, each of the centers should create a unique identity by defining specific technology deliverables to achieve in the next five years. IEI should enlarge the geographical footprint by opening more centres in the country to cater to the needs of the growing members and serving them better.

- A Pan-India IEI Communication Network

We live in a networked world, and IEI is collaborating with National Research Organizations, Educational Institutions, Industry and State Governments on various programs. I propose that IEI needs to strengthen in-house automation and join the National Information Grid, and it will be our endeavour to facilitate the establishment of the necessary ICT infrastructure at Headquarters, Fora and State/Local Centres on high-priority. This would also help us deploy digital library, programmes, and MOOCs to facilitate continuous learning amongst members and AMIEns.

- Roadmap for the Engineering Staff College of India

Technology is a key factor in promoting rapid, economic all-inclusive growth. It is essential to develop high-calibre human resources to serve the nation. I propose that the leadership shall prepare a roadmap of the developmental activities at ESCI, an important organ of IEI, in the run-up to the Centenary Celebrations. These self-funded activities must include new sustainable engineering programmes, including adequate infrastructure development. The proposed activities must also support IEI's objectives and current and future educational requirements, including the establishment of "University".

ESCI is doing substantial work with organizing quality training programmes, and has great potential to become an International Hub for Continuing Education by serving the international training requirements, particularly members of the WFEO, FEISCA, FEIAP, SAARC, and UNESCO. To help realize this goal, special interest will be given to the activities of ESCI. The ESCI roadmap should cover the transition from the current to the desired future state in the next 5 years, with short- and long-term performance targets, and a comprehensive strategy for accomplishing the objectives.

ESCI should prepare an overall development plan for the next 5 years in terms of resources, infrastructure, and deliverables. ESCI should also develop focused advanced programmes to be delivered countrywide in both off-campus and on-campus modes.

- National Design and Research Forum

NDRF has emerged as an important Research Centre, thanks to very dedicated team of intellectuals associated with it; this capable team has nurtured NDRF to pursue greater engineering challenges. NDRF's Collaborative Research Ecosystem that fosters participation by Academia, Industry and Entrepreneurs, and Research Organizations with a robust knowledge-management process and framework has been successful in delivering significant research output to India's major collaborative research initiatives and programs. This well-recognized model of "NDRF's Collaborative Research Ecosystem" can be replicated in many IEI Establishments including other institutions.

To continue the growth of innovations, patenting, and strengthening design capabilities, I propose to create Research Chairs in each Engineering Division of IEI at NDRF and other places to nurture the research culture of each of these engineering disciplines.

I also recommend that NDRF should initiate a "Research Conclave" to inspire, motivate, and give thrust to engineering education and R&D. In addition, we need to bring together eminent practitioners of R&D, young engineers, and students in an informal atmosphere to encourage meaningful dialogue. These conclaves would also recognize the talent and research initiatives of individual organizations through Awards and Rewards.

We all know the efforts invested by NDRF on the National Design Awards over the last 45 years. However, the present awards cover a few disciplines only. To promote advancement of engineering design and facilitate exchange of ideas on its different aspects, I propose that the Design Awards be expanded to include all the fifteen engineering disciplines, and a new category be included to recognize significant accomplishments in Interdisciplinary or multidisciplinary engineering. The Awards would include R&D Institutions.

I propose NDRF should establish an Incubation Centre to support brilliant and innovative ideas from young enterprising engineers and students. The kick-off events for various groups have been identified at the Incubation Centre.

- Water Management Forum (WMF)

WMF should play a major role for the country sever-essential area of Water Management. WMF should support the national requirements and policies, such as irrigation, water networking and grids, improving the quality of drinking water, including the National Mission for Clean Ganga, and so on.

Rural Development Forum, Safety and Quality Forum, and Sustainable Development Forum should also expand their activities to encompass the larger issues facing the society in their field of specialization and interest. I assure the leadership of full support in their efforts to broaden the canvas of activities.

- Membership: A New Dimension

Membership size of professional societies is a key metric in addition to technical activities and publications. We will need to grow the numbers, and make IEI the professional society of choice for tomorrow's engineers in India. To do this, it is essential for us to create attractive giveaways which will kindle interest amongst members. It is also essential reinvent and present ourselves by in an effective and lucid manner in the available media, including social media. I will be requesting all of you to participate, assess, and suggest measures to gain the mindshare of the new entrants to the Indian engineering fraternity.

I am of the opinion that we must build a member-centric culture at IEI. By providing an overall better experience to members, increasing the opportunities for member engagement, stimulating membership growth, and progression avenues, we will be able to stimulate the growth of IEI membership rolls, and this would facilitate increased Member-Institution engagement. My mission is to create a systems that gives direction to grow our membership strength two-fold in time for the Centenary Celebrations.

- Expanding the Publications Activities

Publications and Journals are essential to establish thought leadership for any professional body. The tie-up with Springer has been successful in improving metrics, such as usage-factor and downloads. We need to work on making IEI publications world-class and become the preferred Publications for today's engineers to present and share knowledge. These measures will go a long way in strengthening the "The IEI Brand".

I urge the members and engineering fraternity to come forward to participate in the development of Policy Reports, Monographs, Country Reports, and Blogs on topics of interest in engineering and technology.

- Centenary Celebrations—A Historical Milestone

As we move towards the "Centenary Milestone", we will need to capture moments of glory for posterity to inspire the future generations. To inspire future generations of engineers, I propose to create a "Hall of Fame" that captures and freezes the key moments in the journey of Indian Engineering. I also propose a new initiative to capture the historical narrative of each Indian engineering accomplishment to establish the context and significance.

I also urge all of us to identify technologies that can be promoted by patenting, productization, and commercialization. We should have a sizable repository of 100 technologies across IEI engineering disciplines that can take the country forward and position India as a leader in technology. IEI should consider various methods of achieving this portfolio including facilitating development in the collaborative mode, incubating start-ups, and partnering industry through innovation clusters with the objective of collaborating with industry through Patents for productization / commercialization, so that they are useful to the society.

- Strengthening "IEI Alumni"

Alumni have the potential to be most loyal and generous supporters of an institution. IEI is fortunate to have a large number of Alumni. Many organizations are benefiting immensely through Alumni activities. Alumni's are role models for current and future AMIEns and are International Ambassadors to make IEI bigger, stronger, and more successful. I propose to take this initiative further by creating an "IEI Alumni Cell" and expand to each State/Local Centre to increase alumni activities.

- Women for Engineering

Women engineers are participating in large numbers in the IT industry and they can be a major source of IEI membership growth. One of the initiatives I have in mind is creating a Women's Cell at IEI Headquarters to focus on developing programs and activities that will promote the entry of women into Indian engineering programs. These could include interaction sessions with women entrepreneurs, facilitating networking with MSME, and related activities. I request women engineers to come forward and share their suggestions on how we could strengthen the diversity in the Indian engineering workforce.

In the last 12 years, IEI has helped me in my professional attainments. Now, it is the time for me to serve with greater responsibilities to the IEI Community.

I pledge with enthusiasm, dedication, and sincerity as the President of lEI,

- To Lead all efforts to promote the IEI Vision
- To Execute the IEI Mission
- To Promote the IEI Values

I am confident that with your support and guidance, I will be able to take forward all these initiatives to bring in a transformation in IEI; and thereby create an effective platform to collaborate and network for the professional advancement of Engineers.

Let me recall Sir M Visvesvaraya, who postulated: "Think and Act Institutionally". His postulates have been my guiding principles, and will continue to be a beacon guiding me during the tenure as President of this esteemed Institution.

Let us all work together and initiate "Thinking Institutionally". Once started, I am confident that by our cumulative efforts, collective strength, shared vision, and wisdom, we will be able to surmount all challenges, progress our activities, and move to better days ahead.

I would like to convey the New Year Greetings to all Members and their families; and hope that the coming year will be a promising and fulfilling year!

Thank you, one and all ...

Dr L V Muralikrishna Reddy — a Brief Profile

Dr. L.V. Muralikrishna Reddy is the youngest-ever person to occupy the exalted office of the President of The Institution of Engineers (India) spanning over the last 94 years.

Dr. Reddy obtained his Bachelor's Degree in Chemical Engineering, Master's in Energy Systems, and Doctorate in Energy Management. He has pursued research work at the University of Kentucky, USA, as a Post-Doctoral Fellow.

He has over twenty-four years' of multifaceted professional experience leading and pursuing contemporary research, technology development and engineering projects and Consultancy ranging from Design, Research, Development, and Management spanning Government, Industry, Academia, and R&D establishments. His contributions are significant in building India's collaborative research ecosystem to develop critical technologies.

As Director of the National Design and Research Forum, the premier R&D Wing of the Institution of Engineers (India), Dr. Reddy has been instrumental in building a viable and successful national research ecosystem to promote industry-academia collaboration. He has established the teams, processes and tools for applied R&D; and has successfully led interdisciplinary research programs to develop solutions for a wide range of complex engineering challenges.

His areas of expertise and current interests include Chemical Engineering, Engineering Education and Accreditation, Energy Systems, Collaborative Research, Institution Building, Micro Air Vehicles, Skill Development, Sustainability Platforms, and Technologies for Societal Needs.

He had earlier served as Director of MHRD's Continuing Education Programme. He is the Founder President of Foundation for Educational Excellence and Engineering Design and Analysis Forum to cater to the needs of research aspirants for capacity building in academic research.

Over the last decade, he has tirelessly promoted the cause of Indian Engineering and has held multiple positions at national and state levels. Dr. Reddy has played a significant role at state and national level in articulating, proposing, and implementing transformation of IEI's flagship activities-Education, Examination, Accreditation and AMIE programs; conceptualizing and organizing the Indian Engineering

Congress, Conventions, Seminars and Events; promoting Membership Growth; Networking professionals and institutions under IEI platforms. He has contributed significantly to proposing and implementing reforms to strengthen the relevance of IEI's AMIE program to meet India's engineering needs.

Mr H C S Berry

President 2015-16

Presidential Address

Respected Past Presidents, My dear fellow Council Members and Corporate Members of The Institution of Engineers (India).

With great pleasure**,** I welcome you all to the Annual General Meeting of The Institution of Engineers (India), hosted by our Assam State Centre at the pristine city of Guwahati. I feel honoured by the gracious presence of our revered Past Presidents, our Council Members and other Corporate Members. It is my privilege to stand before you as the President of The Institution of Engineers (India), which has completed 96 years of glorious journey and heading towards its centenary. I express my heartfelt gratitude to the Council for providing me this unique and prestigious opportunity to serve our Institution, in particular and the Nation in General, I profess that, with your kind guidance and advise, I shall make all effort to uphold the great standards set by or illustrious Past Presidents and other engineers of eminence.

1. Origin of Indian Engineering Congress

The history of the coveted Indian Engineering Congress, organized by The Institution! of Engineers (India) held at different locations of the Country every year, can be traced back to 1987 when the, nomenclature was changed to Indian, Engineering Congress instead of Annual Convention to provide a wider spectrum to the event. The Indian Engineering Congress is intended to broaden the interface of interaction amongst the engineering community from the) country as well as from the prominent parts) of the, globe. The Indian Engineering Congress is intended, to throw open the threshold of knowledge to all members and nonmembers and provide them with a forum. The theme of this year is '21st Century Engineering — The Make-in-India Pathway'. The aim of, this Congress has been to enlighten the technical fraternity about the developments and achievements, of the country in various fields of Engineering & Technology which have contributed immensely towards fostering and rejuvenating the Indian Economy, thereby enabling it to with stand the challenges ahead.

2. The Way Forward

India can boast of a unique blend of democracy, demographic dividend and demand, The new government has struck the right, note by earnestly pursuing the issue of skill development to ensure that skilled workforce is available for manufacturing. The "Digital India Mission" would ensure that government processes remain in tune with corporate processes. An environment conducive to development and growth is being created. India has to increase manufacturing for creating opportunities of employment. "Make in India" is the clarion call to the world to come here and invest in manufacturing. Investment friendly policy measures are being contemplated for investors — both Indian and foreign, to do business in India. Indian Engineers & Technologists have, an important role for realizing the mission "Make in| India'. Though Engineers are professionally competent, there may be areas where improvement is required for making them world class professionals. Areas of skill deficit in some of the disciplines of engineering and technology are to be identified and impressed upon for transforming his vision into reality. World class infrastructure is required to give an impetus to manufacturing. Engineers and Technologists would be involved in building dedicated freight and industrial corridors, smart cities, highways, ports and providing clean energy, including solar and nuclear energy. There is also a need to develop world class research infrastructure. Achievements of our development programmes are another important area to be firmed up in such a manner as would lead to environmentally sustainable actions and negotiations on these issues. Digitization of India will help a great deal in making manufacturing very efficient. Effective project management should be the bed rock of our future projects & programmes.

The recent spectacular advances in various fields of Science & Technology have had a profound impact on sectors like health, agriculture, communication, transportation, and defence. These advances have been driven by intense R&D, largely emanating from science laboratories in the West, and by their transformation into new products or processes that have flooded world markets. These, in turn, shower vast economic rewards on those nations that have the will and vision to make science and technology the cornerstone of their development programmes. The world is today sharply divided by a technology divide that separates the technologically advanced countries from the technologically backward ones. India, as of now, has definitely shown promises as far as economic growth is concerned, but has been struggling to achieve sustainable economic growth) self-reliance in technology development and in gaining an important global position. The political structure and economic model of our nation cannot be aligned with the models of developed nations. Consequently, we need out-of the-box thinking along with their effective implementation; and sustenance to ensure strengthening of the economy.

3. The Mandate of The Institution of Engineers (India) vis-a-vis the Need of the Hour

The focus of The Institution of Engineers (India), since its inception has been "to promote and advance the science, practice and business of Engineering in all its branches in India". The underlying implication may be interpreted as that the Institution which is strategically equipped for promotion & furtherance of S&T in India may be a key player in fostering innovation aimed at improving the prevailing Socio-economic conditions. This assumes paramount importance keeping in mind the declaration of the then Prime Minister of India, in the 97th Session of Indian Science Congress held on 3rd January, 2010 at Thiruvananthapuram, Kerala that the Government has declared 2010-2020 as the "Decade of Innovations". The main aim of this declaration is to develop a favourable ecosystem in the country to stimulate indigenous innovations and to produce solutions for the societal needs in terms of healthcare, energy, urban infrastructure, water and transportation. The Science, Technology and Innovation Policy or S.T.I Policy 2013 is in furtherance of the declaration and aims to bring fresh perspectives to promote innovation in the changing context.

3.1 Skill Development

India's concerns about achieving higher economic growth for development of all sectors are likely to be addressed by promoting Innovative Enterprises which will contribute to societal well-being and boost economic wealth percolating to the lowest societal strata. Energy and environment, food and nutrition, water and sanitation, habitat, affordable health care, skill development and unemployment are the major identified areas that need new structural mechanisms and models, while the promotion of scientific temperament, enhancing skill for application of technology amongst the youth, making careers in science, making research and innovation attractive are some of the other major elements identified for connecting science with the people and attracting skilled manpower in the S&T sector. Institution has identified the issue of skill development as a thrust area and has delved into the prospects of imparting skill enhancement training to target participants through ESCI— an organ of IEI. By setting up well equipped laboratories in core engineering disciplines, ESCI looks forward to fulfilling the training needs of AMIE and other young engineers who need industry-orientation.

3.2 R&D Grant-in-Aid Programme and IEI-Springer Journals

Being recognized by the Ministry of Science and Technology, Govt. of India as a Scientific and Industrial Research Organization, The Institution of Engineers (India) has taken up the role of promoting R&D through funding and active participation, either in solo or joint mode, with identified organizations. The initiative was launched way back in 2001 with a modest amount of fund where the role of the Institution was confined to that of a mere funding body. The modest enterprise has now manifested into a full-fledged program which has percolated to the student community across the country. The role of the Institution has also undergone a paradigm shift from that of a technology funding body to that of a technology collaborator and facilitator. The proclaimed beneficiaries of R&D Grant-in-Aid scheme over the last three Financial Years have been over 200. However, we need to consolidate and try and emerge as a 'Category Leader' especially in the area of undergraduate research funding. The highlights of the R&D program of IEI may be attributed to comprehensive yet user-friendly application process, rapid finalization and intimation to applicants, quick disbursement of one-time grants, and dedicated support system to applicants, which have culminated in wider acceptability and overwhelming recognition for the scheme.

We are pleased to mention that several research works carried out from these R&D funding have been published in the IEI-Springer Journals which speaks volume about the success of the initiative. Further, a Compendium reflecting IEI funded research carried out in the frontier areas of technology is being brought out over the last couple of years which have been widely appreciated and acknowledged by various industries, government and non-government organizations.

3.3 AMIE Section A & B Examinations

The Associate Member of The Institution of Engineers India (AMIE) is a professional certification given by The Institution of Engineers (India) which has been widely acclaimed and have shaped myriads of careers over the last few decades. It continues to be the most sought-after course for the working professionals because of its uniqueness and flexibility. Conducted from over 60 Centres across the country, it provides wide, choice to the examinees to appear at exams from their centre of choice, at the same time creates new openings through career enrichment. The contribution of AMIE students pronounced in Government Sectors like

Defence, Railways, CPWD and Public Sector Undertakings, UPSC Engineering Services Examinations and many have rose to prominence in these areas. However, it is felt that corporate world is yet to realize the significance of this unique program and it would be our endeavour to reach out to them and sensitize them on this issue. There are issues with quality of technical education system in our country and the employability of our engineering graduates. I strongly feel that, as the largest professional body in the country, we have a proactive role to play in bridging the gap which exists between technical curriculum and expectation of the industry.

4. IEI Centenary Celebrations: An Unique Opportunity to Prove our Mettle

The Institution of, Engineers (India) is marching towards its 100 years of glorious contribution to national development. IEI was established to fulfill the need for trained technical manpower with the ability to contribute in national development. The country is now passing through a stage where rapid economic development through use of latest technologies and skilled manpower is being stressed by the government Here is an opportunity for IEI to consolidate on its historical legacy and build further to contribute

significantly in the period from now to completion of its 100 years in 2020. 'While marching towards 2020, IEI needs to highlight its strength and strive to craft positive public image by rendering dedicated and transparent services to its stakeholders, developing Skills, improving ethical standards and focusing on safe and quality business models of growth. As the year 2019 marks the 150th year of Mahatma Gandhi's Birth, that also gives an impetus for IEI to highlight how engineering is being applied in the service of mankind to improve the downtrodden and the deprived in the society by its members and its Centres throughout the country.

We have identified several areas which demand attention in the build-up to the centenary celebrations like:

1) Each State and Local Centre may develop its own programme schedule, with their regional/state/local focus based on broad framework developed by IEI with the primary objective of showcasing IEI image.

2) Prepare a Centenary Volume on the History of Engineering and the Role of IEI to be formally inaugurated during the centenary year.

3) Each Division may identify a domain area and publish a compendium focusing on the latest developments and happenings.

4) Expansion of Membership to all sectors of Engineering including new and upcoming disciplines. Membership target should be minimum additional 2 lakhs Corporate Members by 2020. In this regard, I must express my sincerest gratitude to my predecessor, Dr L V Muralikrishna Reddy, who had provided fillip to, this vision through his 'each one bring one' initiative.

5. Strengthening of International Linkages

The IEI has been a respected member and in many instances a founder member of various multilateral institutions like WFEO, FEIAP, FIESCA, fib, IEA, etc. and over the years, our wise and respected Presidents and Council Members understood the importance of international exposure and networking and also headed or were part of |the governing bodies of those prestigious organizations. Similarly, we have a large number of MOUs with other organizations similar to ours. I congratulate our Immediate Past President Dr. Reddy for continuing this tradition and entering into some additional MOUs in the past year also. Our Hon'ble Prime Minister has brought\in a new look to the way in which countries look up to India. India is being looked upon to take leadership in various fields and disciplines. I intend to take further and make more effective our interaction with these multilateral and bilateral partners.

6. Indian Engineering Congress

The main objective of the 30th Indian Engineering Congress will be to identify the challenges of making India the manufacturing , hub, where products are manufactured for both the Indian market and the world market and how, to organize, and develop the engineering profession to meet these challenges. The discussion in various sessions at the Congress was aimed at addressing issues, which may include policy issues, legal issues, environmental and sustainability issues, Organizational issues, development of systems, training and skill building, effective Communication, and profession-related issues such as engineering consultancy. Some of the presentations were aimed at determining strategies to ensure that engineering profession is effectively regulated for making engineers accountable to society, practicing their profession ethically and meeting the requirement for enabling trade in engineering services. The main takeaway will be the identification of engineering & technical issues and strategies for the success of 'Make in India' mission.

To achieve the goal, we shall try our level best to establish The Institution of Engineers (India) as an Institution of National Importance and give a new dimension to our higher education programme by introducing user-friendly learning methods suitable for in-profession student members. Our efforts to encourage R&D by students of engineering institutes will be strengthened further and we shall try to bring-out more and more technical publications of high quality so that IEI retains its recognition and place in the global forum. Interaction with our members, institutional members and collaborative organizations will be made more frequent and meaningful. Continuous persuasion will be made to extend our membership so that IEI's presence is felt at each and every corner of our country.

I am fully aware that the tasks are tough but I am confident that with the whole-hearted support of all of you, we can achieve those and can usher a new era of development for our beloved Institution. We should remember the famous words of Henry Ford that says “Coming together is a beginning; keeping together is progress; working together is success”. Let us join hands and work in tandem to uphold the banner of this prestigious Institution.

I wish each of you, your family members a very happy and prosperous new year 2016.

JAI HIND

Mr H C S Berry — a Brief Profile

Mr H C S Berry has been elected the President off The Institution of Engineers (India) for the Session 2015-16 during the 687th Council Meeting of the Institution hosted by the Kochi Local Centre at Kochi on September 26, 2015, crowning an exemplary career spanning close to four decades. Mr Berry, a resident of Chandgarh, is an alumnus of the erstwhile Thapar Institute of Engineering & Technology (currently Thapar University), from where he did his graduation in, Civil Engineering way back in 1961. Mr H C S Berry started his career with the Irrigation Department, Government of Punjab and served in various capacities like Executive Engineer & Superintending Engineer spearheading various important projects. He superannuated as Chief Engineer. Mr Berry has unparalleled multifarious experience of over 35 years in the areas of Water Resource Management, Canal Water Distribution System & Irrigation Projects, Infrastructure Development, Hydro Electric Power projects, River work, Drainage & Flood Control measures. He also has proven administrative experience of Controlling Establishments and conversant with public relation skills. Mr Hatesh Chander Syne Berry had been associated with The Institution of Engineers (India) over the last four decades. His active association with IEI stated way back in 1993 when he became Member of Punjab & Chandigarh State Centre Committee. He became the Chairman of the Punjab & Chandigarh State Centre for the Session 2005-2007 and had been associated with IEI Council for almost a decade. Mr Berry is extremely conversant with Institutional Bye Laws and Regulations, Financial Norms, Service Rules related matters. By virtue of his profound knowledge in these areas, Mr Berry has served as Chairman for the following important Committees/Board namely Land & Building Committee, Civil Engineering Division Board, Bye-Laws; Committee, Bi-partite Agreement Committee, Besides, he has been Member of Finance Committee, Examination Disciplinary Committee, Legal Committee, All India Students Committee, Service Rules & Headquarters Management Committee for Advancement of Technology & Engineering, BOG-NDRF, BOG-SDF, BOG-SQF, BOG-WMF, IMC-fib etc. Mr Berry is also a Member/former Member of the following prestigious bodies/societies: Executive Council of School of Planning & Architecture New Delhi; Indian Council of Arbitration; International Council of Consultants land on the Panel of Consultants in Dispute Resolution Category; Indian Society of Construction Law; Governing |Council; of Thapar College of Engineering & Technology, Patiala; Board of Studies in Civil Engineering, Punjab University Chandigarh: Board of Studies in Construction Technology and National Institute of Hydrology — Roorkee. Mr Berry has travelled widely across the globe on various assignments and as a part of delegation team representing IEI and other professional societies. To mention a few, Member of Indian Delegation to attend IEA Convention held in Sydney, Australia in 2012; Member of Indian Delegation to attend Annual Civil Engineering Conference of American Society of Civil Engineers (ASCE) held in U.S.A. in 2013; Member of Indian Delegation to attend Annual Civil Engineering Conference of American Society) of Civil Engineers (ASCE) held in Panama in 2014 etc. He has also visited U.K., France, Malaysia and Singapore on specific assignments. He is a keen golfer and member of Chandigarh Golf Club. He is socially well connected and associated with the prestigious Satluj Club, Ludhiana (Punjab).

Mr H C S Berry will assume office as the President at the Ninety-sixth Annual General Meeting of the Institution to be held at Guwahati on December 2015.

Mr Navinchandra B Vasoya

President 2016-17

Presidential Address

It is my pleasure and honour to welcome you all to the 97th Annual General Meeting of The Institution of Engineers (India) being hosted by the West Bengal State Centre at Kolkata with active assistance by the IEI Headquarters. It is really heartening to see the presence of our respected Past Presidents. I am grateful to them for their gracious presence. I am also thankful to the Council Members as well as Corporate Members for their presence. It is with great pleasure that I stand before you this afternoon as President of this esteemed Institution for the next term. I am grateful to the Council for having bestowed upon me the opportunity for serving the Institution in this prestigious position.

I am aware and deeply conscious about the great responsibilities bestowed upon me and it will be my endeavour to keep up the standards set by my eminent and illustrious predecessors. With the vast pool of talent, deep knowledge and wide experience available with our Council colleagues in particular and with the Corporate Members in general, from all walks of Engineering Science and modern technology, I am sure it would be possible to ensure further growth of this great Institution.

India is poised to become an economic superpower in the coming years and in achieving this goal, the role of engineering professionals is highly crucial. It is heartening to note that India is producing more than a million engineering graduates in diverse disciplines through 4000+ Engineering Educational Institutions (EEI). Thousands of Polytechnic Colleges and Industrial Training Institutes are educating similar numbers / Diploma holders and skilled workers. While the issue of work-force numbers is being managed, quality is yet to attain the requisite standards to be counted amongst the best in the world. We should remember that we are educating professionals for employment anywhere in the world and also in emerging technology areas. When the country has the advantage of demographic dividend, education and skill development have to go hand in hand concurrently with employment generation.

The strong and consistent economic growth of our country has raised expectations. Fulfilling these expectations is a real challenge and this will be the core concern in the performance of our Engineering fraternity. IEI has been playing an active role in this direction as the AMIE alumni from the Institution are well trained and experienced in their respective discipline of Engineering. I am confident that the Engineering fraternity shall face this challenge successfully and meet the expectations bestowed upon them.

The Institution has been imparting non-formal engineering education since 1928 to working technical personnel who wish to upgrade their engineering educational qualification. There is no parallel to what it has contributed to create skilled engineering work force to supplement and meet the requirements of the country. As of now, the Institution is creating a pool of about 3000 qualified engineers each year. The Institution of Engineers (India) has been playing a dominant role in shaping and promoting the Engineering education in the country. The Institution was responsible for according accreditation to the engineering colleges and institutes and their curricula of teaching for several decades till AICTE was established. The Institution of Engineers (India) has rigorous set of norms and very high standards in the planning and conduct of our examination system.

Not only should we grow and prosper as engineers, but also make the engineering profession alive to the needs of the nation. IEI is committed to serve the society. Since last year, we have taken upon ourselves to spread the message of 'Swatchh Bharat Mission' through our Centres and I am sure that our outreach programme in this regard will contribute to the objectives for which it is meant for, especially in the rural areas. Our work must help us grow and help society to prosper and in the process, bring about congruence and harmony. In order to accomplish this objective, IEI has established different Fora. These are the National Design and Research Forum's objective is to identify talent and extend support in furtherance of research and development in emerging areas of engineering. Similarly, Rural Development Forum, Water Management Forum, Sustainable Development Forum, Safety and Quality Forum are relentlessly working to accomplish their respective objectives. In addition, the Engineering Staff College of India —an entity of the Institution is engaged in organizing various professional development programmes including post-graduate courses for practicing engineers and technologists.

Keeping the contemporary needs of the country and society I feel that the Institution can play a significant role I would like the IEI to concentrate on a five-point program, which we may call 'Panchamrut'. These are:

1. IEI Continuing Education and Skill Development Program
2. IEI Start Up Initiative
3. IEI initiative for woman empowerment in engineering
4. IEI Outreach Programme with Industry
5. IEI Placement Drive

I shall cover these ideas briefly.

IEI Continuing Education and Skill Development

Recent years have seen rapid advancement in technical knowledge and expertise. Scientific and technical manpower resource is one of our greatest strengths today, but poses the greatest challenge as well in terms of their optimal utilization towards growth and economic development of the country, as we continue to depend on external expertise and support in areas that we are capable of handling perhaps even better.

My predecessor has also stressed upon promoting skill development activities of IEI. He has correctly mentioned that there is a need to have serious relook at what is being taught in our educational institutions, the method of training etc. The coordination between the industry, academia and the decision and policy makers therefore assumes greater importance. Efforts have been made in this direction in past several years, however there is still a scope for improvement.

In order to address this situation, the need for continuously updating the knowledge and developing various skills has become necessary. IEI, since 1928, imparts upgraded technical knowledge to technicians with high skills in order to make them at par with the national and international standards by providing them required theoretical base. I would like our Centres to address the gap between education and skill.

Our Engineering Staff College of India (ESCI) needs to take up an initiative as they have got experienced faculty to conduct various courses. They need to reach out to engineers staying away from Hyderabad by collaborating with the Centers of the Institution as well as our neighbouring countries and working out courses with affordable fees for the new engineers as well as middle level and senior level working professionals.

IEI Start Up initiative

I believe that IEI should utilize and integrate the deep domain expertise available in various engineering disciplines. We should encourage the entrepreneurial zeal of our members and students and to this end we may establish an incubator for assisting them establish start ups by providing them a common platform where they can interact with the venture capitalists/angel investors so as to see that their ideas take wings. We may also take help from the Government of India in this initiative.

I would like IEI Start Up Incubators Initiative to be taken up by our Centers to build a strong eco-system for nurturing innovation which has its own cascading effect in overall development. IEI needs to work out detailed guidelines in this regard so that uniformity is maintained.

IEI Initiative for Woman Empowerment in Engineering

Looking at the fact that a large number of women are taking up engineering, not only in IT but in other branches of engineering, I find it necessary that there enhanced inclusivity in activities of the Institution be given due impetus.

The activities might include organizing annual two-day women engineering students conference called Engineering Inspiration, promoting engineering role models, upgrading knowledge continuously through interactive sessions with women entrepreneurs/seminars/workshops/talks/presentations, etc. I request women engineers to come forward and share their suggestions in this regard.

It is my vision and fond hope that, to encourage activities of women engineers, we may think of reserving some percentage of seats in Executive Committees of the Centres and in Council of IEI exclusively for women engineers.

IEI Outreach Programme with Industry

An area of challenge is to align our activities with the needs and expectations of industry. I feel that IEI with its vast network and outreach in all parts of the country is well-poised to address this challenge.

IEI should intensify its interaction with industries through a structured framework. Regular programmes in association with industry bodies and sharing the platform with them on contemporary technical issues will definitely create a milieu of IEI-Industry bonhomie. The blending of knowledge with business will definitely help in achieving 'Sabka Saath Sabka Vikas', which is the clarion call of our respected Prime Minister.

IEI Placement Drive

We can feel proud that the AMIE examination of IEI is at par with similar graduation programmes of the best engineering institutes of our country. Our continuing education programme is robust, run methodically and the syllabus is also contemporary in nature. We, therefore, should now initiate the process of placement of our graduates in leading organizations throughout the country and abroad. I would like IEI Headquarters to look into this aspect centrally and devise a framework to assist our graduates to avail the opportunity. In this endeavour, the Centres would be required to play a central role and I seek their cooperation in this regard.

Apart from the above "Panchamrut" I would also like to emphasis on the Centenary Celebration of IEI, for which my predecessors have already planned through a well thought framework. I would also like to focus on events which will showcase the contribution of the Institution and of the Engineering fraternity at the global stage. We also have planned to setup convention centers which can be used by our partners organizations as well as others to organize events contemporary relevance. I would also like our major Centres to organize International Seminars in various disciplines of Engineering. I invite suggestions from all our Members which would enable us to mark this seminal milestone in a befitting manner.

As President of IEI, I am taking the baton from Shri H C S Berry, who has steered the Institution during challenging times and his contribution in the development of this Institution is exceptional. I hope that the valuable guidance of the Past Presidents, active support and cooperation of the Council and Corporate Members shall make my job as President meaningful and fruitful. I will do my utmost to ensure that the image of this great legacy Institution rises to higher heights.

Jai Hind

Mr Navinchandra B Vasoya—a Brief Profile

Mr Navinchandra B Vasoya, FIE, has been elected as the President of The Institution of Engineers (India) for the Session 2016-2017, during the 691st Council Meeting of the Institution hosted by the Uttarakhand State Centre on September 24, 2016 at Haridwar.

Mr Navinchadra B Vasoya graduated in Chemical Engineering from Gujarat University. Mr Vasoya ventured into the business of manufacturing edible oil, de-oiled cake, solvent refined oil and managed the solvent extraction plant along with the refinery and oil mill including export of de-oiled cake and HPS kernel, He also established two manufacturing units for dyes and intermediates. He was also engaged in preparation of end-to-end project reports for various manufacturing units. As a Managing Director of a company involved in consultancy, project management, industrial and engineering projects, construction of public infrastructure projects, industrial estate development etc, Mr Vasoya delivered projects of national importance. He is a dynamic, result-driven leader with proven record in growth & customer development and also a Professional Engineer having diversified rich experience and expertise in Purchase, Sales & Marketing, Business Development, High Value Project Execution, Team Development, Mentoring & Coaching, Industrial Management, Marketing Management, Construction Management, Lead Generation, Forming Strategic Alliances, Financial & Operational Management and Compliances.

Mr Navin Vasoya is associated with and has been serving The Institution of Engineers (India) for more than two decades in various capacities. He was elected as Honorary Secretary for Session 2000-2002 and as Chairman, Gujarat State Centre, IEI for the Session 2001-2004. He was Vice-President of IEI during Session 2011-2012. During his long association and involvement in the activities of EL he has served as the Chairman, Chemical Engineering Division Board during various Sessions. He led the delegation of IEI to attend IEA Convention at Sydney, Australia in 2012. He is Member of the Executive Committee of Federation of Engineering Institutions of South and Central Asia (FEISCA) and also FEISCA Representative to the World Federation of Engineering Organization (WFEO). Mr Vasoya is a Member of the Technical Standing Committee on "Information and Communication (WFEO - CIC)" for the term 2016-2019.

Mr Vasoya is also the Fellow of International Council of Consultants, Fellow of Indian Institution of Technical Arbitrators, Life Member of Indian Society of Technical Education, Member of Gujarat Chamber of Commerce & Industries and Member of Indo American Chamber of Commerce.

He has presented various papers at National and International Seminars and has widely travelled countries like United Stated of America, United Kingdom, Germany, Belgium, France, Switzerland, Canada, Australia, China, Indonesia, Singapore, Malaysia, Thailand, Kenya, Nepal, Bangladesh, Sri Lanka, etc. on various professional assignments.

Mr Sisir Kumar Banerjee
President 2017-18

Presidential Address

Respected Past Presidents, My dear fellow Council Members and Corporate Members of The Institution of Engineers (India) .

It's a matter of great pleasure and honour to welcome you all in this 98th Annual General Meeting of The Institution of Engineers (India), hosted by the Tamilnadu State Centre at the heritage city of Chennai. I feel elated by the gracious presence of our esteemed Past Presidents, Council Members and Corporate Members. I feel humbled and privileged to stand before you as the President of The Institution of Engineers (India) which has completed 97 years of glorious journey and heading towards its centenary. I express my heartfelt gratitude to the Council for the onerous responsibility that they have bestowed upon me to serve this great Institution as its President and through it to the profession and the Nation at large. I assure you that, with your support, guidance and participation, I shall make all-out efforts to uphold the high standards set by my illustrious predecessors and other engineers of eminence. I take this opportunity to thank my immediate predecessor Mr Navinchandra B Vasoya who has left for me a strong platform to start with and to develop it further.

The prestigious Indian Engineering Congress was first held in 1987 with the intention to bring together the engineering fraternity of the country as well as from the prominent parts of the globe to discuss challenging contemporary issues from an engineering perspective and evolve with the deserving solutions. This year, the 32nd Indian Engineering Congress is being hosted by Tamilnadu State Centre of the Institution at Chennai during December 21-23, 2017 on the theme "Innovation in Engineering: Competitive Strategy Perspective'. Engineering innovation is a philosophy that leverages the emergence of a new technology or combination of technologies that offer worthwhile benefits. Major innovations require new skills, levels of market understanding, leaps in new processing abilities, and systems throughout the organisation. With the advancement in innovation in Engineering and Technology, these fields have become more sophisticated and interdisciplinary in nature. In a dynamic business environment, constant innovation is essential to meet the evolving challenges.

In this connection, it is pertinent to mention that after three successive Five Year Plans, our planners realised the necessity of agricultural development in tandem with development in the industrial sector. As of today the necessity of all round agricultural development with the application of innovations in the domain of Science & Technology has become a paramount necessity. The dearth of adequate attention during successive plan activities made the Planners and Economists think about agricultural development through technological pursuit. Development of ground water and surface water resources are looked upon as complementary activities to establish planned irrigation facilities ensuring intensive cultivation programme for increased agricultural production.

I, therefore take the opportunity of placing before this learned body, that notwithstanding. The massive scale of development that have taken place in other areas of infrastructural development viz Railways, Highways, Aviation etc., there is much to be done for comprehensive and efficient ground water and surface water utilisation throughout the country. It is imperative to improve this area for meeting effectively the goal of making India self sufficient in the production of food grain for the entire population of the country.

It is hoped that our scientists and technologists shall be putting in their heads together to device ways and means with necessary input of knowledge in order that the shortfall in the area of efficient utilization of Ground Water and Surface Water resources could be successfully tackled and the challenges faced by our agricultural technologists could be met with vigour and enthusiasm gleefully.

A 'Developing India' can aspire to become 'Developed India' when the quality of life in rural India becomes comparable to the quality of life in the developed countries. For this to happen, technology has to be advanced to cater to the need of rural India. All round development may mean development in agriculture, economy, technology, industry, commerce, defence, optimal utilization of natural resources, education, health, culture, environment, quality of life, international relations, etc. At the same time, we need large-scale industrialization and it is essential to adopt technology to suit rural needs. For both the cases, increased interaction between academia and industry is essential. Engineers, from time immemorial, have demonstrated their capability for great technological feats that have transformed the world around us. AS we move into the 21st century, our expectations have soared to new heights and we are looking for a cascade of engineering advancements that will enable us to face the challenges of accelerated nation building through economic upliftment and sustainable development. The biggest challenge today before the engineers is to see how best development can take place with the least carbon footprint on the environment, creating environment — friendly, ecologically appropriate, energy saving developmental options — sustainable not only for the present generation but also sustainable for the emerging generations down the line.

It is worthwhile to state that the necessity of Skill Development enterprise in both public and private sectors, to meet the huge deficit in the requirement of technically skilled manpower, for pulling on the mass scale technological growth for the country to make itself reliant in all the major areas of technological and industrial development. It is heartening to note that Government Of India has given adequate attention to planning and organising large scale infrastructure to help people to be trained in different spheres of technical jobs and applications, so as to fulfil the requirement of technically skilled manpower for the development of the country and to reduce the colossal scale of unemployment in the country. Being the largest professional body of Engineers in the country, IEI, has taken up a commensurate role for meeting the country's requirements, as far as practicable.

The colonial structure of Public Administration is still being maintained even after 70 years of Independence since 1947. The Government of India constituted an Administrative Reforms Commission (ARC) which submitted its report to the Parliament in 1968-69. The Government, by and large, subsequently accepted the recommendations of the ARC but as far as the implementation is concerned, much remains yet to be done. Out of the total expenditure of any Plan, it can be mentioned that 70% of it is handled by the engineers and technologists. As such it is of paramount necessity for motivating them by way of according status commensurate to the responsibilities handled by them. Unless the Government both at Centre and State level, takes adequate steps to give them their due share in the Administrative set up of the country, the tempo of developmental works is likely to be affected. As such I would like to appeal to the Government both at Centre and the States to act wisely and quickly to implement the recommendations of the Administrative Reforms Commission (ARC) which still remain untouched.

The Institution of Engineers (India) is marching towards its 100 years of glorious contribution to national development. IEI was established to fulfill the need for trained technical manpower with the ability to contribute in national development. The country is now passing through a stage where rapid economic development through use of latest technologies and skilled manpower is being promoted by the government. Here is an opportunity for IEI to consolidate on its historical legacy and build further to contribute significantly to this cause. It is a great pleasure to inform you that we will celebrate Centenary Year from 13th September 2019 to 13th September 2020. To effectively mark the significant milestone, we propose to create a committee consisting of high-level experts from within the Institution and outside the Institution. for laying out the activity plan, such that the Centenary event of the IEI creates a long-term impact on the technological profile of the country. Some of these initiatives could be in the form of publication of special volumes. through renowned publishers in the areas of successful technological achievements by Indian Engineering Fraternity; helping in development of research in technological areas. by arranging lectures by international experts in chosen fields; by installing progressive series of conferences on subjects that deserve rapid systematic development. Each State and Local Centre of IEI may develop its own programme schedule, with their regional/state/local focus based on broad framework developed by IEI, with the primary objective of showcasing IEI image. I invite suggestions from all stake holders to make our Centenary truly a hallmark event for the engineering fraternity.

It is needless to reiterate that IEI is the first and oldest Accreditation Body in the country for engineering programmes and has continued the task of providing quality benchmarking in engineering education. It is interesting to mention that recognition of B.Tech degrees in Indian Institute of Technology Kharagpur, was granted by IEI in 1956. Indian Standards Institute (ISI), now designated as Bureau of Indian Standards (BIS), is the natural successor of the Institution for standardization movement in the country and is the national standards body of India.

The Institution of Engineers (India) also provides thrust on Research & Development (R&D) activities by its members associated with different engineering institutes and also by the students of those institutes by providing appropriate financial and infrastructural support. The present approach of funding R&D projects at undergraduate and post graduate levels is basically similar to the national programme on awareness and enhancing mindset of young engineers for R&D. A Compendium reflecting IEI funded research, carried out in the frontier areas of technology, is being brought out, over the last six consecutive years and same have been widely appreciated and acknowledged by various industries and government/non-government organizations. The sustained effort of promoting of R&D in this manner has resulted in recognition of IEI by the Department of Industrial and Scientific Research, Govt. of India as a Scientific and Industrial Research Organization (SIRO). I take this opportunity to share with you that the five Journals of The Institution of Engineers (India) which are published through Springer, have taken IEI to new heights and IEI has attained global recognition through these prestigious publications.

The Institution is a pioneer in the field of specially-designed engineering education in the country. During 1928, when the infrastructure of Indian education was inadequate, the Institution in its wisdom, coupled with a visionary view, started conducting Sections A and B Examinations in engineering disciplines with a view to providing and opening for education of personnel engaged in engineering works, who were not fortunate enough to have collegiate education. Passing of Section A& B Examinations is recognized as requisite qualifications for engineering services by the Union Public Service Commission as well as by the Ministry of Human Resource Development, Govt of India for higher education and equivalent to B.Tech programme. With the passage of time, the strength has increased manifold. The candidates who clear this examination have a high acceptance by industry and academic institutions both in India and abroad due to their practical skills coupled with engineering knowledge. This course has benefitted especially those who are already in the profession, as technicians and diploma holders.

Members are the strength and source of inspiration for us. Therefore, my focus will be on regular communication with them, organising more technical activities to ensure their participation and providing them additional benefits aimed at enhancing their professional knowledge. My aim will be to enroll a larger number of members from all disciplines of engineering science and from the technical student community in particular.

The focus of The Institution of Engineers (India), since its inception, has been “to promote and advance the science, practice and business of Engineering in all its branches in India”. The underlying implication may be interpreted as an Institution which is strategically equipped for promotion & furtherance of Science and Technology in India and which would emerge as a key player in fostering innovation aimed at improving the prevailing socio-economic conditions. In furtherance of these objectives, the Continuous Professional Development paradigm and formation of a knowledge learning society to share experiences and expertise, are of paramount importance to our Institution.

To provide enriched version of learning opportunities for our members, we are launching our Improved Learning Management System using modern technologies with the help of a top tier IT Company. This will help the Senior Technician members to avail of a systematic method of learning and pre-assessment at different stages before the final appearance for the examinations. We hope that all of them will avail and be benefitted from this facility which is a unique kind of learning system for Continuous Professional Development (CPD). During my interaction with AMIE graduates, it was felt that an on-line employment management system is essential to assist them to search for better job opportunities. This will also be made accessible to prospective employers, who can choose an engineer with required skill-set from this searchable database.

Technicians’ Chapters of IEI were established primarily to conduct technical activities for Senior Technician and Technician Members. The Technicians’ Chapter is intended to provide a forum for mutual professional sharing of ideas amongst the members and thus promote their professional and intellectual acumen and inculcate a feeling of ‘belongingness’ to the fraternity. These need to be further energized with the objective of providing maximum benefits to those associated with these Chapters. We propose to do some collective thinking to further enhance the capabilities of all of our units like the Engineering Staff College of India, State/Local Centres of the Institution and at the same time initiate new activities that will benefit our members and students in a synergistic manner.

In a landmark achievement, The Institution of Engineers (India) obtained the full membership of the International Professional Engineers Agreement (IPEA) for India at the Biannual International Engineers Meetings held at Kyoto, Japan on 17 June 2009. The International Professional Engineers Agreement (IPEA) is an International Recognition Agreement for Professional Engineers between the engineering organizations in the member jurisdictions, which creates the framework for the establishment of an international standard of competence for professional engineering. By virtue of being a full member of the International Professional Engineers Agreement, The Institution of Engineers (India) represents India and has been empowered to establish and maintain the India section of the International Professional Engineers (IntPE) Register, The International Professional Engineers (IntPE) registered with IEI, may receive credit when seeking registration or license in the jurisdiction of another member, i.e this will facilitate an engineer in mobility across the member countries. IEI, has a robust and stringent procedure complying with the requirement of IPEA for registration as International Professional Engineers.

The Institution of Engineers (India) is a constituent of World Federation of Engineering Organisations (WFEO), Federation of Engineering Institutions of Asia and the Pacific (FEIAP) and Federation of Engineering Institutions of South and Central Asia (FEISCA). I would like to highlight the fact that The Institution of Engineers (India) is actively engaged in conducting various activities in line of the objectives of these global and regional engineering bodies and our efforts have been widely appreciated.

The biggest challenge today before engineers is to see how best development can take place with the least impact on the environment creating environment friendly, ecologically appropriate, energy saving and sustainable developmental options—sustainable not only for the present generation but also sustainable to the emerging generations down the line. The clarion call of our Prime Minister on "Swachh Bharat", "Make-in-India", "Smart Cities", "Digital India", "Bharatmala Project", "Sagarmala Project" and other programmes, provide us the much needed opportunity to develop indigenous environment-friendly technology and engineering practices. Engineers form the backbone of technology and infrastructure development of the country and it is therefore incumbent on this fraternity to rise to the occasion in contributing their professional skill related to such programme of the Government/Public Sector. It is my earnest request to all members to come forward to fulfill the goals of the Nation and share your valuable experience and thought which will be carried forward by us. Therefore, our interactions with National and International bodies, Government departments, R&D organizations, Industries, etc. have to be strengthened through planning and conducting regular collaborative technical activities of national importance. Simultaneously, our collective efforts in this direction would enable larger recognition of engineers, which is the need of the hour.

With these few words, I invite you all to join, assist and support us in our endeavours to deliver our services towards the nation so that IEI becomes a prime mover in the field of science and technology.

I express my gratitude for your august presence here and extend my sincere thanks once again for giving me a patient hearing.

Wishing you all Marry Christmas and Happy New Year 2018,

Mr Sisir Kumar Banerjee—a Brief Profile

Mr Sisir Kumar Banerjee, FIE, an alumnus of IEI has been elected as the President of The Institution of Engineers (India) for the Session 2017-2018, during the 698th Council Meeting of the Institution held on September 23, 2017 at Shimla. Mr Banerjee has been associated with the IEI Council for over a decade. He is an acclaimed Civil Engineer with specialization in Water Resources Investigation & Development. Mr Banerjee is also the Past Vice-President; Immediate Past Chairman, West Bengal State Centre; Past Chairman, Civil Engineering Division Board and Past Convener (re-designated as Director), Rural Development Forum of the Institution. Mr Banerjee has held positions of significant responsibility, evident from his tenures with many bodies/organizations in various capacities in the past, such as, President, Section on Engineering Sciences, Indian Science Congress Association; Chairman, Indian Engineers' Federation (an apex body of State and Central Engineering Services Associations of India); Vice President & Secretary General, Eastern Regional Federation of State Engineering Services Associations (ERFSESA); Secretary General, Federation of Associations of Engineers and Technical Officers' (FAETO), West Bengal and Treasurer, Indian Science Congress Association, Kolkata Chapter. Mr Banerjee is known to possess exemplary negotiation skills which came to the fore as he could successfully resolve anomalies of pay structures of Engineers and Technologists of Govt. Organizations and Undertakings, through fruitful interaction with 6th Central Pay Commission, in his capacity as Chairman, Pay Committee of Indian Engineers' Federation. He has demonstrated considerable organizational skills and had been involved in organizing numerous activities under the banner of IEI (Rural Development of Forum) in the form of All India Seminars and programs in rural areas of West Bengal, Odisha, Maharashtra with the objective of improving the lifestyle of the rural people. Also, he has organized International Conference under the banner of Indian Association of Hydrologists, West Bengal Regional Centre on the various issues of sustainability. Mr Banerjee has served on important decision-making bodies of IE like -- Chairman, Service Rules and Headquarters Management Committee; Member of different Committees viz Finance, Education Examination & Accreditation, All India Technicians' Committee, Equivalence Committee; Committee for Advancement of Technology and Engineering (CATE) and Membership Committee. He has attended many prestigious events abroad as a key member of IEI delegations, like 44th Executive Committee Meeting of Federation of Engineering Institutions of South and Central Asia (FEISCA) at Kathmandu and 55th Convention of The Institution of Engineers, Bangladesh at Dhaka. He has also served many international bodies, such as, Committee on Poverty Alleviation of FEISCA and has organized Seminar on 'Poverty Alleviation in West Bengal'; Indian Member Committee of Federation Internationale Du Beton (IMC- fib). Besides, being a Fellow of the Institution, he is also associated with many professional bodies like Fellow, Indian Association of Hydrologists, Roorkee and Life Member, Indian Science Congress Association. He has a penchant for organizing mega technical events and has an enviable record at it. He has served as Convener, Logistic Committee — World Congress on Sustainable Development held at Kolkata in 2000; and other Indian Engineering Congress. He was Chairman, Organizing Committee of 31st Indian Engineering Congress held at Kolkata in 2016 which was widely acclaimed and appreciated by all. Mr Sisir Kumar Banerjee will assume office as the President at the Ninety-eighth Annual General Meeting of the Institution to be held at Chennai on December 23, 2017.

Mr T M Gunaraja
President 2018-19

Presidential Address

I approach today's installation as President of The Institution of Engineers (India) with a sense of both honour and humility in the historic city of Udaipur, vibrant with the stories of patriotism, bravery and sacrifice. I would like to sincerely thank the Council of the Institution for reposing their faith in me and I look forward to our collective leadership in various endeavours for the betterment of the engineering fraternity in the country.

I feel it appropriate to remember, on this occasion, the doyens of engineering profession who, with self-less dedication and commitment, contributed to the development of engineering in the country such as Bharat Ratna Sir Mokshagundam Visvesvaraya, Sri R N Mookerjee, Dr A N Khosla, Dr Triguna Sen, Padma Bhusan Dr K L Rao, Nawab Zain Yar Jung Bahadur, Er Dildar Hussain, Dr M S Thacker, Dr A P J Abdul Kalam and many other illustrious engineering personalities. It is with pride we note that many such luminaries were also at the helm of affairs of this august Institution and responsible for its multidimensional growth and we salute their devotion, dedication and leadership.

The status of engineering profession in India gained prominence during 1916-18 owing to a report submitted by the Industrial Commission. There were endeavours to advance an industrial society to safeguard and enhance the status of the profession. Sustained efforts by a group of Indian and British Engineers brought "The Institution of Engineers (India)" into its rightful place and the Institution was registered on September 13, 1920 under the Companies Act of 1913 with Madras as the "Province of Registration". The Registered Office was shifted to Calcutta on November 11, 1920. In recognition of valuable services for the cause of advancing the engineering developments, the Institution was granted the Royal Charter in 1935.

The Institution is a pioneer in the field of specially designed engineering education in the country through the AMIE-Section A&B examination. The AMIE programme has been devised to serve the interest of a large number economically challenged working professionals to enhance their professional skills and career enrichment.

The Institution has also taken up the role of promoting R&D Grant-in-Aid Programme, which is recognized by the Ministry of Science & Technology, Govt. of India as a Scientific and Industrial Research Organization (SIRO), through funding and active participation with identified organizations. The initiative was launched in 2001 and has manifested into a full-fledged programme which has percolated to the student community across the country.

IEI Entities

With this modest initiation, this great Institution has been increasing its activities and is engaged in multidimensional development towards the growth of engineering profession in the country. As of date, there are 123 State and Local Centres with a corporate membership strength of over 200,000 members and about 520 Institutional members.

The Institution has six fora and an autonomous organ for meeting the challenges related with specific areas for national interest. Of these the Engineering Staff College of India (ESCI) organizes various technical training courses throughout the country to upgrade the technical knowledge of practicing engineers and technologists. The six fora, namely, National Design and Research Forum (NDRF) Rural Development Forum (RDF), Water Management Forum (WMF), Sustainable Development Forum (SDF) and Safety & Quality Forum (SQF) and National Skill Development Forum (NSDF) have been engaged in promulgation of knowledge in a specific engineering domain for the benefit of the society at large.

International Linkages

We have six Overseas Chapters viz. Abu Dhabi, Bahrain, Dubai, Kuwait, Nepal and Qatar. We have bilateral relationships with 33 sister professional societies of international repute. IEI is a member of various international professional bodies such as World Federation of Engineering Organization (WFEO), Federation Internationale du Beton (fib), Federation of Engineering Institutions of South and Central Asia (FEISCA) and Federation of Engineering Institutions of Asia and Pacific (FEIAP). IEI is also member of International Professional Engineers Agreement (IPEA) since 2009. The IPEA is an International Recognition Agreement for professional engineering to create the framework for the establishment of an international standard of competence and also empowers each member organization to establish a section of the International Professional Engineers (IntPE). IEI operates the Indian section and holds International Professional Engineers Register and also certifies International Professional Engineers in India as per the system and procedures adopted by IEI in line with international requirements and also in the true spirit of IPEA requirements.

TOWARDS THE NEXT CENTURY

I would now like to enunciate some of the focus areas of IEI in the years ahead as we march towards the next century.

Digital Learning Paradigm

IEI's vision is to promote an environment to enable ethical pursuits of professional excellence for engineering fraternity in the country so as to provide leadership for serving the humanity in an inclusive manner. IEI Vision Document emphasizes on 'functional areas' and 'key result actions' to fulfill the obligations specified in the objectives under the Royal Charter. Acknowledging the vision of IEI, we need to look beyond our present structure of delivering education. We need to believe that technology can be a great enabler to improve teaching, learning and administrative processes, towards a progressive, knowledge based society. We should aim to offer our members options for cloud based platform services developed in close collaboration with academia and industry community. I would like to convey my appreciation to my worthy predecessor for initiating a digital learning paradigm for our students and corporate members, which I would like to implement in real earnest.

Membership Growth and Inclusivity

The involvement of manufacturing industries in technical activities and corporate membership organized by the Institution is to be given special impetus. We need to engage industries by organizing dedicated program on themes relevant to our industries. There is a pressing need of inclusivity of industry professionals in our various engagements in order to stay relevant and sensitive to the requirements of our industries. Plans are afoot to involve trade bodies with the objective of developing meaningful synergy and benefit from each other's expertise. Further, with enhanced participation from industries, our membership database will be more inclusive and would ensure more participation from industry in our technical events. It is worth mentioning that with modest effort we have witnessed substantial increase in participation from industries in events organized by the Institution. This is evident from the encouraging response we have received in IEI Industry Excellence Award 2018. Also, this year we have witnessed a surge in papers received from Industry as part of the Congress proceedings.

As engineering is evolving and conquering newer frontiers the role of women engineers are coming to the forefront. Women engineers have proved their worth in all disciplines and have established themselves adept at handling various responsibilities assigned to them. The Institution of Engineers (India) need to formulate policies which will attract more women engineers as its members and ensure their active involvement in its various pursuits.

Skill Development

It has also been observed that though there have been plenty of initiatives to empower our youth through missions like 'Skill India', the advocacy of such initiatives needs dissemination. The Institution has envisaged the need for 'youth empowerment' and has come up with skill development initiatives offered through our fora like the National Skill Development Forum. These initiatives will foster economic growth of India as it aims at utilizing the existing nation's talent base, create additional employment opportunities and empower MSMEs. I would like all our fora to implement the same in their respective domain of expertise.

ACADEMIA-INDUSTRY INTERFACE

It will be my endeavour to give special attention on the issue of employability of our engineering graduates. Industries are interested to employ those who possess industry-ready skills including ability to work in a team, good communication and leadership, critical thinking, problem solving and managerial abilities to meet the challenges. This has necessitated industry to look for support from academia. At present, in the era of knowledge economy, a productive interface between academia and industry is a definite requirement. Both the domains have realized the need to increase mutual interdependence to bridge the gap between academic institutions and corporate bodies ensuring that their respective objectives are relevant and contemporary. I would like IEI to step in as a facilitator to establish the much needed synergy between academia and industry. Here I would like to laud the efforts of my worthy predecessor for embarking upon a programme for bringing academia and professional engineers on a single platform to share ideas, thoughts and provide policy inputs by way of academia-industry interface.

CENTENARY CELEBRATIONS

We are all aware that The Institution of Engineers India is marching towards its 100 years of glorious contribution to national development. The country is now passing through a stage where rapid economic development through use of latest technologies and skilled manpower is being stressed upon by the government. This is an opportunity for IEI to consolidate on its historical legacy and build further to contribute significantly in the period from now to completion of its 100 years in 2020. While marching towards 2020, IEI needs to highlight its strengths and strive to craft an enhanced public image by rendering dedicated and meaningful services to its stakeholders, developing skills, improving ethical standards and focusing on quality business models of growth. Incidentally, 2019 marks the 150th year of Mahatma Gandhi's Birth and this also gives an impetus for IEI to highlight the manner in which engineering is being applied in the service of mankind to make a difference in lifestyles as well as in sustainable development.

We have identified several areas which needs attention in the build up to the Centenary celebrations such as

a) Each State and Local Centre may develop its own programme schedule based on local imperatives.

b) Prepare a Centenary Volume on the History of Engineering to be formally inaugurated during the Centenary year.

c) Each Engineering Division of the IEI may identify a domain area and publish a compendium focusing on the latest developments/happenings in their respective fields.

d) Enhance corporate membership and make it more inclusive.

DYNAMIC ROLE OF IEI CENTRES

Our Centers, which have an excellent geographical coverage, need to respond in a big way. I would like to exhort our Centers to evolve innovative ways to effectively engage and create platforms for knowledge sharing between policy makers, corporate members, industry, academia and students using contemporary communication technologies. Centres should focus on conducting technical activities specially National Conventions and All India Seminars relevant to contemporary themes. I would like to emphasize that it is imperative that the National Conventions be organized in locations which have industry clusters in their respective specific engineering domain as well as academic Institutions. This, I am sure, would result in enrichment of the deliberations and lead to useful recommendations which can then be sent to stakeholders as inputs for policy making.

I am fully aware that the challenges before us are many, but I am confident that with the whole-hearted support of all of you, we can achieve our goals and usher in a new era of development of our Institution.

I wish each of you, your family members a very happy and prosperous New Year.

Thank You

Mr T M Gunaraja — a Brief Profile

Mr T M Gunaraja, FIE, a man of clear vision, exceptional foresight and diligence, has been elected as the President of The Institution of Engineers (India) for the Session 2018-2019 during the 702nd Council Meeting of the Institution held on September 22, 2018 at Goa. He is a renowned personality in institution building and also a multi-disciplinary educationist for over 30 years.

A Mechanical Engineer from The Institution of Engineers (India), he has a Masters in Production Engineering from Anna University and a Masters Degree in Business Administration (HR). He is the founder and owner of three renowned educational ventures — Madras Institute of Engineering Technology, TMG College of Arts and Science and TMG College of Hotel Management, located in Tamilnadu.

Mr Gunaraja has been in the Council of The Institution of Engineers (India) for almost two decades. He has served the Institution in various capacities including: Member — Board of Governors of National Design & Research Forum and Rural Development Forum. He has also been associated with many important Committees, such as, Committee for Advancement of Technology & Engineering, Strategic Plan Committee and Finance Committee.

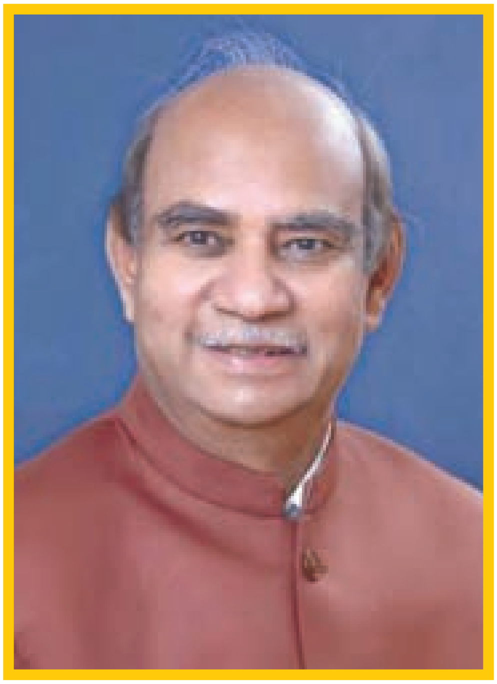
Mr Gunaraja served as Chairman of Tamilnadu State Centre of the Institution for the session 2012-2014. By virtue of his dedicated services to the Institution, Mr Gunaraja became the Vice President of The Institution of Engineers (India) for the session 2005-2006.

Mr Gunaraja, known for an inclusive educational outlook, has played a pivotal role in opening IEI Local Centres and Student Chapters in Engineering Colleges of Tamilnadu. He has been keenly involved in professional issues and was the Founder Chairman of Institution of Mechanical Engineers and Member of – Institution of Automobile Engineering (India), Institution of Civil Engineering (India) and The Council of Engineering & Technology (India).

Mr Gunaraja has been Chairman and Co-chairman of the 28th and 32nd Indian Engineering Congress held at Chennai in December 2013 and 2017 which was graced by the presence of Honourable Presidents Shri Pranab Mukherjee and Shri Ramnath Kovind, respectively.

His unwavering passion for professional excellence earned him many laurels, like Technology Excellence Award presented by the former Prime Minister of India, H D Deve Gowda at Indian Technology Awards — 2014 and Bharat Vidya Shiromani Award by the International Institute of Education & Management in February 2015.

Mr T M Gunaraja will assume office as the President of The Institution of Engineers (India) at the Ninety-ninth Annual General Meeting of the Institution to be held at Udaipur on December 23, 2018.



Er Narendra Singh, *FIE*

President 2019-20

Presidential Address

Respected Past Presidents, My Dear Fellow Council Members and Corporate Members of The Institution of Engineers (India);

I feel honoured and privileged to have been installed as President of The Institution of Engineers (India) for the session 2019-2020 in the historic city of Hyderabad. I accept this great honour bestowed upon me with a sense of humility and a commitment to work towards meeting the objectives and goals of this great institution. I thank all council members, well-wishers and friends especially in the engineering community and also those who are present here, whose encouragement and support have provided me an opportunity to serve the institution to the best of my abilities. I like to extend my sincere gratitude and thanks to the National Council of The Institution of Engineers (India) for the confidence reposed in me and electing me unanimously as the President of this largest and premier professional body of the country. My sincere thanks to Dr T M Gunaraja, who has rendered able leadership to this Institution prior to me. I shall seek guidance and wholehearted cooperation from the esteemed Past Presidents and Council Members of this Institution to discharge my responsibilities for achieving the objectives and goals of this great Institution.

On this occasion, I would like to pay my due regards to the doyens of engineering profession such as Bharat Ratna Sir M Visvesvaraya, Sir R N Mookerjee, Dr A N Khosla, Dr Triguna Sen, Dr K L Rao, Dr Satish Dhawan, Dr U Ramachandra Rao and many more whose excellent contributions formed the foundation of development of our country.

Genesis of The Institution of Engineers (India)

The Institution of Engineers (India) was established in the year 1920 based on the recommendations of Er Thomas Holland, Industrial Commissioner of India to provide scientific and technical inputs to an ever-growing industrial economy of our country.

The Institution was registered on 13 September 1920 in Madras and subsequently moved to Calcutta with Sir Thomas Ward as its first President. He was succeeded by Sir R N Mookerjee, an eminent engineer cum entrepreneur who took over as President of the Institution in the Inaugural Ceremony at the first Annual General Meeting held in the hall of "*Asiatic Society of Bengal*" in Calcutta.

The Emerging Scenario

This Institution has already entered into the 100th year of its establishment on 13 September 2019. The centenary celebration was inaugurated by the Hon'ble Governor of Tamil Nadu. He advocated that *engineers are the real architect to make the country prosperous.*

This Institution was established with the twin objectives of 'Indianization' and 'Industrialization' at a time when the development of the country was being thought of in strategic terms. These objectives have largely been met and engineering has been widely acknowledged as the backbone of the multi-functional development in the country. To augment these, there is a need for signing of more MoUs with the Government Departments such as MSME, CPWD, MNRE, MHRD and Ministry of Skill Development, industry organizations, and academic institutions. During the centenary year, many more events will be organised by this Institution to enhance the image of IEI.

Under IEI Centenary activities, Curtain Raiser Events have been organised jointly with Indian Railways at various Centres of IEI in the country. It is now time to formulate new goals for the next Century to set meaningful and pragmatic objectives.

I would like to accelerate such events at many more Centres during my tenure also. I, therefore, humbly request all the concerned to extend their wholehearted support to mobilise such events in the Centenary Year to enhance the image and visibility of IEI.

IEI's Role as Scientific and Industrial Research Organisation (SIRO)

I am happy to mention here that The Institution of Engineers (India) is recognised as Scientific and Industrial Research Organisation (SIRO) by Govt. of India. IEI is promoting the R&D Grant-in-Aid programme which is recognised by the Department of Scientific & Industrial Research Organisation (DSIR), Ministry of Science & Technology, Govt. of India. This R&D Grant-in-Aid is provided by IEI to encourage researches by IEI members who are faculty and students of engineering institutes.

National Level Challenges & Engineering Congress

I would like to echo in word and spirit the sentiments expressed by the first Indian President of the Institution of Engineers that "*Industrial progress of India is only possible through engineers, supported by adequate financial power. The newly formed institution will prove a powerful and effective organization to promote the efficiency and training of Indian engineers, without which the unrivaled resources of India cannot be developed*".

The prestigious Indian Engineering Congress was first held in 1987 with the intention to bring together the engineering fraternity of the country as well as from the different parts of the globe to discuss contemporary issues. The issues of green environment, depletion of fossil fuels, infrastructure creation, employment generation and imparting the overall quality of human lives; etc will be the prime focus during my tenure. These issues will be addressed to fulfill the demand of the country for nation-building.

We are hosting this 34th Indian Engineering Congress on the theme "Societal Engineering – Imperatives for Nation Building".

IEI's Section A and Section B Examination

The Institution of Engineers (India) is a pioneer in the field of specially-designed engineering education in the country. During 1928, when the infrastructure of Indian Education was inadequate, the Institution in its wisdom, coupled with a visionary view and in conformity with the provisions of the Royal Charter, commenced conducting Sections A and B Examinations (popularly known as AMIE examination) in engineering disciplines. It creates an opportunity to many who due to their economic conditions and otherwise would not be able to avail admission to an engineering college and pursue a formal engineering degree course.

It is also a known fact that IEI was the first accreditation body in India since 1935 and regulated the engineering programme in India. There have been some recent developments in Engineering education and some emerging courses have been included in the curricula to meet the requirements of industry and employability.

IEI is also implementing to upgrade its syllabi of AMIE Courses to make it at par with the courses of premier engineering institutes. Recently, there have been many advancements in the technologies and many more new topics such as biomedical engineering, artificial intelligence, internet of things, global warming and climate change; etc have been added in the respective discipline of the undergraduate courses. To keep the IEI's AMIE Courses at par, the syllabi need to be revised which will be taken up on a priority basis during my tenure.

IEI Professional Certifications

The Institution of Engineers (India) provides some important certificates to the competent engineering professionals in recognition of their experiences, contributions, and achievements in the field of engineering and technology. These include:

- International Professional Engineers (IntPE) Certificate
- Professional Engineers (PE) Certificate
- Chartered Engineer Certificate

The certificates to the competent professional engineers will be given due importance in my tenure.

IEI Professional Publications

This Institution brings out some engineering journals of international repute, publishes monthly Newsletters containing technical events of international, national and regional levels. More quality papers will be added to the technical journals.

IEI Membership Growth

There are 124 State and Local Centres with a Corporate membership strength of more than 2.30 Lacs Corporate and about 5.50 Institutional Members. There is a need to increase the corporate membership of IEI. I make appeal to the office bearers of all the State/Local Centres to put their best efforts to enhance the membership in their respective Centres. IEI should continue its efforts to attract competent engineering professionals for national PE and International PE Membership. The Heads of the institutions/industries should also be approached by us to request them to come forward to get their organisations enrolled as Institutional Member.

Professional Engineers Bill

There are several Acts for different professions in the country; such as the Architects Act, Indian Medical Council Act, Pharmacy Act; etc but so far, there is no such act for the engineering profession. The Institution of Engineers (India) has been putting its best efforts since long to bring Professional Engineers Bill in the country to safeguard the engineering profession. The basic purpose of this Bill will be to register engineers through an assessment process in the national register. Many a time Govt. of India took initiatives to enforce the Professional Engineers Bill but, somehow, it has not yet been materialised. I am happy to mention here that The Institution of Engineers (India) is the only largest professional body in the country which has been granted Royal Charter Status. I shall highlight the achievements of this prestigious Institution to take lead in the responsibility of Professional Engineers Bill. We shall try our best to project IEI's vast network and infrastructure to take the major responsibility of Professional Engineers Bill. This important issue will be addressed with the cooperation of all engineering fraternity.

Engineering Staff College of India (ESCI), Hyderabad

There is also a state-of-the-art Institution known as Engineering Staff College of India (ESCI) located at Hyderabad. ESCI conducts continuing education programmes, technical training courses across the country to enhance the skills and knowledge of practicing engineers/technologists. It also provides knowledge and training to our budding engineers.

As the constituent autonomous of The Institution of the Engineers (India), the Engineering Staff College of India (ESCI) is at the forefront in the professional development of engineers in both core engineering disciplines and also interdisciplinary domains such as climate change, quality management, intelligent transportation, renewable energy.

IEI's Overseas Chapters

IEI has six overseas chapters; namely; Abu Dhabi, Bahrain, Dubai, Kuwait, Nepal, and Qatar. IEI will also try to set up its Centres in Bangladesh and Bhutan in 2020. Efforts are to be made to open more centres at the locations of neighbouring countries.

International Linkages and Bilateral Relationships

IEI has bilateral relationships with 33 sister professional bodies. IEI is a member of several International engineering professional organisations. They include; WFEO, FEISCA, FEIAP; etc. IEI is also a permanent member of the International Professional Engineers Agreement (IPEA) since 2009. IEI certifies International Professional Engineers in India as per the systems and procedures laid down in the IPEA requirements.

- World Federation of Engineering Organisations (WFEO)

The World Federation of Engineering Organizations (WFEO) was established in 1968 by a group of regional engineering organisations under the auspices of UNESCO in Paris. WFEO is an international nongovernmental organization representing the engineering profession worldwide. WFEO brings together national engineering institutions from over 90 nations and represents more than 20 million engineers from around the world. India is represented by IEI in WFEO. There are various functional committees through which the objectives of WFEO are fulfilled. I am happy to inform, to this august gathering that one of our present member of the council and Past President has been elected with majority of votes as National Member of the Executive Council of WFEO for a period of four years (2019-2023) during meeting of the General Assembly of WFEO on 23 November 2019 in Melbourne, Australia.

- Federation International du Béton (fib)

The fib, Federation International du Béton is a nonprofitable association formed by 42 national member groups and approximately 1000 corporate and individual members. The fib's mission is to develop at an international level the study of scientific and practical matters capable of advancing the technical, economic, aesthetic and environmental performance of concrete construction. The knowledge developed and shared by the fib (fib Bulletins, fib events, fib workshops, fib courses, etc.) is entirely the result of the volunteer work provided by the fib members. The fib was formed in 1998 by the merger of the Euro-International Committee for Concrete (the CEB) and the International Federation for Pre-stressing (the FIP). These predecessor organizations existed independently from 1953 and 1952, respectively. IEI is the national member of fib and taking part in its activities to update knowledge in the field of concrete technology.

- Federation of Engineering Institution of Asia and Pacific (FEIAP)

The Federation of Engineering Institutions of Asia and Pacific (FEIAP) is an international non-profit professional organization founded on 6 July 1978. Being an independent umbrella organization for the engineering institutions in Southeast Asia and Pacific region, the objectives of FEIAP are:

To encourage the application of technical progress to economic and social advancement throughout the world, to advance engineering as a profession in the interest of all people, and to foster peace throughout the world.

IEI is also a National Member of FEIAP.

- Federation of Engineering Institutions of South and Central Asia (FEISCA)

This international professional organization is a federation of professional bodies of some neighbouring countries e.g. India, Bangladesh, Nepal, Sri Lanka, and Pakistan. The objective is to extend the cooperation and exchange of information amongst national Members and promote regional cooperation in utilizing science and technology.

Role of IEI Foras

IEI has created six National Fora in different parts of the country to meet its social obligations. These fora's aims and objectives have been well defined as per their Statutes and Fora are supposed to function pragmatically to create awareness programmes and to meet the requirements of industry, skills, and employability.

Each forum is headed by an able Chairman, who is a Special Invitee to the IEI Council. I would humbly request them to accelerate the progress of the activities of the respective Forum. More and more activities are required to be carried out on International as well as national levels.

I shall expect adequate contributions from the execution of Fora.

- National Skill Development Forum (NSDF), Shimla

The National Skill Development Forum was established at the premises of Himachal Pradesh State Centre, Shimla. The objectives of NSDF are:

“To promote skill enhancement, capacity building, quality training in emerging, evolving, cutting edge technologies for professional engineers, managers, scientists, and young graduates”.

- National Design and Research Forum (NDRF), Bengaluru

To provide a national platform for promotion of design, research and development in a multi-dimensional framework and for useful interaction between designs, research, and development and construction. To recognise creative design talents by the presentation of National Design Awards every year to the deserving professionals.

- Rural Development Forum (RDF), Kolkata

To encourage the development of energy and information pertaining to multifaceted development of rural India and to disseminate information on all matters pertaining to application of engineering for rural development.

- Sustainable Development Forum (SDF), Patna

To evolve and make policy recommendations in the field of sustainable development based on experience gained out of the programmes and exchange of knowledge. The Forum has to undertake specific programmes pertaining to sustainable development in collaboration with central and state government.

- Safety & Quality Forum (SQF), New Delhi

To do network with various national, regional and local government bodies; international and national organizations and inculcate the concepts of safety and quality in application and operations.

To promote and propagate the concept of Safety and Quality through networking mechanism, assist industrial/government unit in undertaking quality and/or safety audits and develop courses, syllabi and course materials for 'Safety Engineering', 'Quality Management' and 'Reliability Engineering' for different levels of engineering education and recommend the same to educational authorities/institutions.

- Water Management Forum (WMF), Ahmedabad

To promote and advance the engineering and practice of economic and cost-effective management of water resources in its totality. The activities and services have attracted the attention of the Central Government and a number of State Governments.

World Engineers' Day

Further, I wish to inform you that the WFEO President Dr (Ms) Marlin Kanga during the WFEO meeting held on 21 November 2019 at Melbourne, Australia announced that the long pending demand of observing “World Engineers' Day” was approved by UNESCO. The “World Engineers' Day” would be observed on 4th March every year as Statutory Day. I have pleasure in announcing that IEI would organise first World Engineers' Day on 4 March 2020 (Wednesday) in India under the aegis of WFEO and it will be continued in the years to come.

I am aware that IEI has been carrying out a large number of activities of international and national repute. However, it is high time to focus on several initiatives to be taken by this prestigious Institution like Skill India Mission, Digital India ission, Solar Mission; etc. These areas can be covered by the respective Forum of IEI. IEI needs to have close linkages with the Central Govt., State Govt., Local Civic Bodies. This may be possible when we take up their responsibilities for nation-building.

Before I conclude, I also wish to touch upon some important aspects such as the strengthening of IEI Alumni and the empowerment of Women Engineers. This is our prime responsibility and duty to pay due attention to promote and strengthen IEI Alumni and Empowerment of Women Engineers.

I am very much aware that we have a number of challenges but these can be achieved with the concerted efforts of all of us. We shall put our best efforts with full dedication and conviction to achieve our objectives to make better and prosperous IEI.

In conclusion, I extend my best wishes to all the dignitaries present in this august gathering of the 34th Indian Engineering Congress.

“If you want to go fast, walk alone,
If you want to go far, walk together"

Wishing you All a Very Happy & Prosperous New Year.

Thank you

Jai hind....

Er Narendra Singh—a Brief Profile

Er Narendra Singh has obtained his degree in Civil Engineering from Motilal Nehru National Institute of Technology, Allahabad and Post Graduation in Irrigation and Hydro from University of Roorkee. Er Singh served Govt. of Uttar Pradesh and Uttarakhand in Irrigation and Power Departments with distinction. He has vast experience in project implementation ranging from small to medium scale hydro projects in broader Himalayan region of India and major hydraulic structures such as head and cross regulators, composite falls and siphon regulators on Madhya Ganga Canal Project.

Er Singh was instrumental for successful rehabilitation of rural and urban families affected by the Tehri Dam Project (1000 MW). His considerable efforts during his tenure with THDC India Limited have won accolades especially for his contribution of this sensitive issue in the laid down timeframe. Based on his experience, he has authored a popular book titled "Rehabilitation and Resettlement: Tehri Dam and other Major Hydro Power Project in India—An Approach for Future".

Er Narendra Singh has rendered exceptional service to The Institution of Engineers (India) in various capacities, founder Chairman of Uttarakhand State Centre and is credited with the construction of a modern building for the Centre in cooperation with State Govt. and PSUs. Er Singh has contributed significantly and added value while serving on many important Committees and the Council of the Institution. He has been a major contributor in various initiatives undertaken in enhancing the role, relevance and image of the Institution.

Er Singh displayed exceptional ability in organizing five Council Meetings of the Institution at various venues. He has been Vice President of the Institution for the Session: 2012-13.

Er Narendra Singh is also credited with focused efforts in promoting regional languages by first time in the Institution publishing "Abhiyanta Bandhu" — a multilingual yearly Journal of Engineering papers as well as a life sketch of "Bharat Ratna Sir M Visvesvaraya" in Hindi.

Er Singh has been recognized through various awards for his contribution to the engineering profession as well as for his involvement in social causes and community development. He has travelled worldwide for project implementation and leisure. He is actively involved in various professional bodies and had been an Executive Member of the "All India Engineers Federation" and Member of National Institute of Hydrology. He is active in the education sector and his interests include horticulture focused on "creating a green environment".

Er Narendra Singh has been unanimously elected as the President of The Institution of Engineers (India) for the Session: 2019-2020 during Centenary Year of IEI by the Council, which is a testimony and recognition of his sterling and long-standing contribution to the Institution and the engineering profession.

The Institution of Engineers (India)
8 Gokhale Road, Kolkata 700020
Phone : +91 (033) 2223-8311/14/15/16, 2223-8333/34
Fax : +91 (033) 2223-8345
e-mail : technical@ieindia.org; iei.technical@gmail.com
Website : http://www.ieindia.org