State of Science and Technology

In the history of the people of India the importance of the nineteenth century which witnessed industrial, economic and social development of a new order heralding the dawn of the modern concept of modernism by overemphasized. It has been rightly said: "the nineteenth century was the great dividing line, and these hundred years changed the face of India far more than the four preceding thousand years." Evidently, the elements of Europeanization of India, the spirit of rationalism and the new awakening which began with the French Revolution and spread throughout Europe then began to penetrate India, albeit in a very small way. Perhaps it is no exaggeration to say that one of the main factors for this development was the introduction of English education which, despite its outlandishness and being limited to certain sections of the people, contributed significantly to the transformation of minds. Particularly in the latter half of the nineteenth century, it may be said that the new idea was conceived and founded at Calcutta, Bombay, Madras, and other places. A number of technical or professional schools were also established in different parts of the country during this period.
STATE OF SCIENCE AND TECHNOLOGY

In the history of the people of India the importance of the nineteenth century which witnessed intellectual, economic and social development of a new order heralding the dawn of the modern outlook need hardly be overemphasized. It has been rightly said: 'the nineteenth century was the great dividing line, and these hundred years changed the face of India far more than did the preceding thousand years.' Evidently, the elements of the civilisation of West, the spirit of rationalism and the new awakening which burst forth in Europe then began to produce, albeit in a restricted way, a noticeable impact upon the minds of the Indians. Perhaps it is no exaggeration to say that one of the main causes for this development was the introduction of English education which, despite it outlandish incongruity and being limited to certain sections of the people, contributed significantly to the transformation of India particularly in the later half of the nineteenth century. It may be noted that the first five universities were founded at Calcutta, Bombay, Madras, Allahabad and Lahore, and a number of technical or professional schools and colleges established in different parts of the country during period of our study.
The later half of the nineteenth century also saw the introduction of the telegraph and railways. The first section of telegraph line was completed in February 1851 near Calcutta between Alipore and Rajghat, a distance of some 15 miles under the supervision of Prof. W.B. O’Shaughnessy who later became the first Director of telegraphs in India. The first railway line was laid in 1853 between Bombay and Thana covering a distance of about 20 miles and by 1871, length covered by the railway rose to 5077 miles. In fact the railway enterprise in India received from the government rather an extraordinary encouragement in preference to the construction of canals for irrigation purposes, as the former proved to be an effective carrier of goods of commercial importance in furtherance of the enlightened self-interest of British. Thus railways created new types of employment, trademarks, new townships and introduced an element of mobility and intercourse among the different sections of the people, with obvious impact on certain social changes even.

Apart from the telegraph and railway, it may be noted that, as a result of the military and commercial motives on the one hand and administrative exigencies which cropped up from time to time on the other, the government had to adopt concerted measures for making then existing scientific service organizations more broad-based and
utilization, as also establishing some new scientific institutions. Thus, among others, the meteorological survey and botanical organization developed all-India character; the geological survey came into being; and research institutes in engineering, bacteriology, medicine and agriculture were established. All these had impact, in their respective spheres, on the political and economic life of a nation. The network of scientific institutions of necessity spread over different parts of the country, and gradual involvement of some of the natives in the scientific investigations, produced noticeably a scientific climate in the country.

Asiatic society of Bengal continued to play a key role for spreading awareness towards science. David Hare in 1808, a member of society moved 'that a committee be appointed for the purpose of physical investigations, the collection of facts, specimens, and correspondence with individuals whose situation in the country may be favourable for such discussions and investigations; and subsequently recommended the formation of two committees - one for Natural History, Physics, Medicine, Improvement of Arts and whatever is comprehended in the general term of physics; and other for literature. From 1818 onwards Physical committee did active work for several years. The biological as well as geological science also received
necessary attention. The naturalists members of the Asiatic Society were greatly interested in scientific investigations of the rich and varied flora and fauna as well as geology and geography of India.

Education in India in the early part of the nineteenth century was neither widespread nor designed towards the promotion of science as well as technical arts and crafts. A few centres of learning then functioning in Bengal, Bombay and Madras were largely concerned with traditional learning and narrow scholasticism.

Lord Minto in his minute on the subject of education in India observed in 1811 as follows: 'it is a common remark that science and literature are in a progressive state of decay among the natives of India from every enquiry which I have been enabled to make on this interesting subject, that remarks appears to me but too well founded. The number of learned is not only diminished, but the circle of learning, even among those who still devote themselves to it, appears to be considerably contracted. The abstract sciences are abandoned, polite literature neglected and no branch of learning cultivated but what is connected with the peculiar religious doctrines of the people. The immediate consequence of this state of things is, the disuse and even actual loss, of many valuable books; and it is to be apprehended, that
unless government interpose with a fostering hand, the revival of letter
may shortly become hopeless, from want of books, or of persons
capable of explaining them.

'The principal cause of the present neglected state of literature in
India is to be traced to the want of that encouragement which was
formerly afforded it by princes, chieftains and opulent individuals
under the native government. Such encouragement must always
operate as a strong incentive to study and literary exertions, but
especially in India, where the learned professions have little, if any,
other support. The justness of these observations might be illustrated by
a detailed consideration of the former and present state of science and
literature at the three principal seats of Hindu learning viz. Banaras
Tirhoot and Nuddea .......... It is serious to be lamented that a nation
particularly distinguished for its love, and successful cultivation of
letter in other parts of Empire, should have failed the extend its
fostering care to the literature of the Hindu and to aid in opening to the
learned in Europe the repositories of that literature.4

By and large in the three presidencies, the position with regard to
general education including course in science was far from being
satisfactory. In the meantime, the Orientalists continued to take
energetic steps to promote oriental learning. Conflicting views and disproportionate efforts, which appeared to raise their heads now and then, seemed to be detrimental to the spread and growth of the new knowledge including scientific subjects.

In order to examine the developments in technical education, it would be worth while to survey the state of affairs in India as a whole. During the period of this study, there was a little technical or industrial education in the country in general and the little that was provided was limited in scope, in quality and effectiveness. During the same period the economy remained substantially underdeveloped and undiversified. Economic growth took place primarily in the production of agricultural raw material. Industry had some promising beginnings, but only a tiny element of the population came to depend on factory labour for their livelihood. Even more significant perhaps was the fact that a large proportion of technical engineering, and supervisory posts remained in European hands.  

The nineteenth century emphasized on craft training in skills such as carpentry. The missionaries opened simple craft schools to equip their students for humble but honest lives and government educational officers tended to follow suit in public schools. Moreover,
the provision of basic craft training was relatively inexpensive venture for the educational services. Education always lacked funds, and those who were inclined to see the system as providing literacy for white collar employment tended to deprecate the diversion of money to technical training. Craft schools met the demand for technical training at the modest cost.6

It was observed that apart from the higher instruction in law, medicine and engineering required for the attainment of University Degrees, there was not as yet anything like a general or systematic provision of technical instruction. The provision that existed was partial and incomplete, directed by no guiding principle.7 It may be mentioned that a number of the schools for industrial training catered primarily to Europeans domiciled in India and to Anglo Indian Community.

In 1875, a committee surveyed schemes for training apprentices in industrial pursuits in the existing establishments. There were at the time 7 such institutions: The ordinance Department, Madras; The Calcutta Dockyard; The Bombay Dockyard; The Workshop of the East Indian Railways; The Scinde, Punjab and Delhi Railway trained European, Eurasians and Portuguese boys.8
There was no definite policy as regards to technical education during the nineteenth century. The court of Directors sanctioned schemes of technical education submitted to them by the Government of India. The origin of the idea of providing technical education to the people of India occurred in the following words of the Educational Despatch of 1854:

“Our attention should now be directed to a consideration, if possible, still more important, and one which has been hitherto, we are bound to admit, too much neglected, namely, now useful and practical knowledge suited to every station in life may be best conveyed to the great masses of the people who are utterly incapable of obtaining any education worthy of the name by their own unaided efforts; and we desire to see the active measures of Government more especially directed for the future to this object, for the attainment of which we are ready to sanction a considerable increase of expenditure.”

At that time, however, a purely literary education had not produced a supply of candidates for employment in excess of the demand, while there were few of those industrial enterprises which had since so largely developed. It was not surprising, therefore, that for a
number of years much attention was not given to the teaching of more practical knowledge.  

When, however, the number of purely literary students unable to find employment grew up and continually increased, and when mining, manufacturing and other large industries began to develop, it was felt that the education in India should be adapted to suit the changed conditions. Moreover, the need of industrial occupation for a larger portion of the people came into prominence with the rapid increase in the agricultural population.

The great advantages of technical instruction had in 1854 been brought home to the public mind in England. A select committee of the House of Commons had in 1835 enquired into the best means of extending among the manufacturing population a knowledge of the principles of Art and Design; and a “Government school of Design established in London, with a system of grants-in-aid to similar schools in the manufacturing districts, had grown out of that enquiry. The progress made, however, was small until the International Exhibition of 1851 drew public attention to the deficiencies as regards art of the English workmen, and a regards science of the English manufacturer. The result was the creation in 1853 of the Department of Science and
Art, which in 1856 came under the control of the Department of Education.

It is therefore, a not altogether improbable interference that the enlightened man who drafted the dispatch of 1854 had, by the passage quoted above, intended to suggest a far-reaching scheme of technical and industrial instruction for India.\textsuperscript{9}

During the year 1863-64 an Educational Committee consisting of some of the chief officers of Government and missionaries interested in education, was convened at Lahore for the purpose of discussing such measures as might be necessary to carry out, to its fullest extent the dispatch of 1854. A good deal of the time of the Committee was devoted to drawing up schemes of study, and to the details of a plan for establishing a school of industry and design.\textsuperscript{10} Conference was held to inaugurate social reforms; a school of art and design was projected and an exhibition of industry was held at Lahore in 1864 with great success.\textsuperscript{11}

Under the auspices of Punjab University College the Mayo School of Industrial Art at Lahore was established in 1875. It intended to train craftsmen in the higher and more artistic branches of their crafts, more especially, in the principles of design, and to exercise a general influence over the more artistic industries of the Punjab by acting as an
aesthetic centre, a school of design, and a source of enlightened
criticism and advice. The main function of this school was to maintain,
restore and improve the application of oriental art to industry and
manufacturers. It comprised of two departments the artistic in which
drawing is taught in all its branches; and the industrial in which
instruction was given in metal work, the art of the carpet-making,
cotton weaving, pottery manufacture, engraving and modeling.\textsuperscript{12}

3. Wood construction and furniture

The following was the curriculum pursued in the school: all
students, without exception, were required to pass through the
following elementary course.\textsuperscript{13}

2. Textile design

1. Black Board demonstration of free-hand drawing and outline
   from the flat.

2. Elementary geometry.

3. Outline from the round.

4. Rudiments of perspective.

5. Light and shade from the round.

6. Plant drawing from nature.

7. Elementary studies of colour.
This course was to be followed by more advanced and technical instruction suited to the aptitude and inclination of the students. The following were the chief subjects taught:

1. Architectural drawing and design suited for mistries and draughtsman.
2. Advanced perspective.
3. Wood construction and wood carving.
4. Modelling in clay and moulding in plaster.
5. Painting in oil.
7. Textile design.

The Mayo School of Industrial Art had 58 students during 1878-79 being an increase of 11 students to the strength of 1877-78. Scholarships were awarded to 22 of the students varying from Rs. 1 to Rs. 10. It was reported with satisfaction the very useful work which continued to be done at the school under Mr. Kipling's direction, who was principal of the school.14 The chief drawback connected with the progress of the school was that public taste as regards the subjects taught was not then so advanced as to offer the prospect of steady
lucrative appointment to the students and it was difficult to provide jobs for them in the Government service.\textsuperscript{15}

In the Presidency of Bombay, a school of industry was established early in 1879 at Ratnagiri. Later another came into being in Byculla. Further, there were three other minor industrial schools, while attempts were also made to have a network of industrial schools under the Municipal Boards.

At Madras, an industrial school named the School of Ordinance Artificers was opened in 1840 by Major Maitland, Superintendent of the Gun Carriage Manufactory.\textsuperscript{16}. Yet another institution known as the school of Imperial Arts was opened in 1850 by Hunter, a Medical man by profession, 'with liberal and enlightened design of creating among the native population a taste for the humanizing culture of the fine Arts.' Hunter also started another school of industry (1851) 'in order to afford to the rising generation of the country the opportunity and means of acquiring useful handicrafts'. The two schools were amalgamated under the name of school of Industrial Arts, which was taken over by the government in 1855. In 1886 there were six industrial schools in Presidency, three in Madras and three in Mofussil. The Average attendance at the schools in Madras was about 60, while the
total number of students of the technical schools and colleges in that year was less than 1000, out of a total of about four and half lakhs of students.\textsuperscript{17}

In Bengal, the Calcutta school of Arts offered courses which were comparable with that of any school of art in England; and there were as many as 157 students receiving training in 1886. In the North - Western Provinces and Awadh, there was practically no school of art worth the name even by the close of the nineteenth century. However, there were two industrial schools at Gorakhpur and Banaras. An interesting development was the establishment at Dehradun of the Imperial Forest School in 1878-1881 for technical training of executive forest officers with the courses extending over 18 to 21 months. In 1856 Bombay Government started the J.J. School of Arts and Industry with the help of Sir Jamshed Ji Jeejeebhoy who provided a substantial endowment.

The first institute of a technical kind was perhaps, the survey school at Madras founded in 1790. Surveying was, later attempted to be taught more widely along with other subjects in institutions of general education. This apparently served the needs of manning the admission of land revenue. Institutions of Technical education proper, however, arose at a somewhat later period, the third and forth decades of the
nineteenth century, a period which, as we have earlier seen was marked by more and more systematic assessment and realization of land revenue on the one hand and by the beginning of a policy of undertaking public works in order to improve the estate as it were. The few institutions which came into existence prior to or about the time of the dispatch of 1854 are; Survey School, Madras; Engineering College, Roorkee; Madras School of Ordinance Artificers, Madras; School of Art and Industry; Calcutta School of Industrial Art; Civil Engineering College, Calcutta; Poona Engineering School.

The Roorkee Institution typifies the early growth of engineering education in this country, some irrigation and road works had started from earlier in the century. Thus the Western Jumna Canal started in 1817, the Eastern Jumna in 1822, the major roads built in North-Western Provinces alone were the Jabalpur – Mirzapore Road, The GT Road, and Agra-Bombay Road. The amount of construction activity carried on in various districts amounted to considerable sums (Rs. 6 lakhs a year) which were in 1841, put in charge of local committees by the North Western Government. Land Revenue settlement activities themselves had cost the government Rs. 23 ½ lakhs upto 1842 and had provided accurate maps of every village in an area of 90,000 square miles. From 1833 onwards the Trigonometrical survey started. In 1845 Thomson, the
North Western Provinces Governor proposed the establishment at the Roorkee canal works of a small class of men from Bareilly, Agra and Delhi college who would receive Rs. 30 per month. While they were under actual training at the work and then be appointed as sub-assistant engineers and surveyors. The foremen posts held out in the beginning were four but were soon increased to 20. In 1847, it was decided to start a regular college with three classes as:

First department – sub assistant civil engineers requiring proficiency in maths as qualification for entrance.

Second department – Eurpoean N.C.C.’s and soldiers possessing ability in reading, writing, plane drawing and elementary mathematics.

Third department – In which native youths desirous of instruction in surveying, leveling and plane drawing were admitted.

The college started working in January 1848. Soon, however, necessity was felt of extending the college. The public works commission of 1851 discovered that the average vacancies for the last four years had been about 22 per annum but the strength of the establishment was far below the wants of the service and should be increased. Besides, an accession of territory had meanwhile taken place in the Punjab with its additional needs of personnel for survey,
proposed irrigation works, road and bridges, and the building of
cantonments. Proposals were therefore, made for (1) admission of
officers both of Royal and East India Company’s armies to study at
school in a circle of 40 or 50 miles round Roorkee apart from the
addition of an economic museum, an observatory etc. to the college. The
first proposal meant that engineers of rank above sub assistant
engineers were also to be trained in India through exclusively recruited
from the army. The second proposal was aimed at securing better
recruits for the third department of the college. Engineering education
in this country thus took another firm stride forward firm, because the
reasons which prompted this expansion were those of growing
applicability not only in North Western Provinces and Punjab but in
other presidencies as well.

Thomson enumerated the following:

1. It will give stimulus to the natives.

2. Most of the North Western Provinces and Punjab revenues are
land revenues which will be increased and supported by the
college.

The expenses of the scheme were according to him negligible
compared to the benefits that would result it, he envisaged further
growth considering that railways not yet come to the North - Western provinces and introduction of Railways and further expansion of canal would create a demand for engineering personnel.19

The Roorkee College was only an expression of wider tendency which had been maturing elsewhere too. Col. Sim, the Chief Engineer and a member of the Madras Board had drawn attention in 1842 to the need for the formation of school of Civil Engineering. Two interesting though unconventional institutions had arisen one out of practical necessity and other from the spare time interests of a army doctor which laid the basis for the later founding of he Madras Civil Engineering College in 1857.

Thomas Munro had raised the Ordinance Artificers’ Corps in 1821 which was in 1833 broken up and distributed among various arsenals at Madras. Major Maitland working in one of these the Gun Carriage factory, set up in 1840 a school for ordinance artificers.

Dr. Hunter’s school of Industrial Art started out of his attempts to lead prisoners in the Madras fail to make improved building material and pottery and to utilize fibrous materials of the district in making ropes, string and paper. The school was, however, started in his own
home in 1850 as the governor Sir H. Ponttinger considered the proposal premature. He taught linear perspective, free hand, landscape and figure drawing, modeling in clay and lithography. Thus it continued till it was taken over by Government in 1855. The school had then pupils number 200 and they increased to 360 after government support became available.

According to Dr. Hunter the school also gave training in good “Building drawing and ventilating materials”, helping students to secure remunerative employment. The two Madras institutions thus worked as a stop-gap till a full fledged engineering college was opened at the Presidency.

Delhousie’s concern for technological education preparing Indians in science and industry for the coming modern world was adequately shared by the education dispatch of 1854, introducing an education system which basically survives till today. Paragraph 80 of the dispatch observed on the subject of technical education: “The success of the Thomson College of Civil Engineering at Roorkee has shown that, for the purpose of training up persons capable of carrying out the great works which are in progress under Government throughout India, and to qualify the natives of India for the exercise of a
profession which, now that the system of railways and public works is being rapidly extended, will afford an opening for a very large number of persons, it is expedient that similar places for practical institution in civil engineering should be established in other parts of India, and especially in the Presidency of Madras, where works of irrigation are so essential, not only to the posterity of the country, but to the very existence of the people in times of drought and scarcity. The subject has been prominently brought under your notice in the recent reports of the Public Works Commission for the different presidencies and we trust that immediate measures will be taken to supply a deficiency which is at present but too apparent." 22 The dispatch also appreciated the work done by Dr. Hunter in Madras.

About the same time as Thomson started his classes at Roorkee, the government of Bengal decided to institute "Professorship of Civil Engineering and Natural Philosophy" at the Hindu College. A year later the Chairs were still vacant for want "a suitable lecturer in Civil Engineering."23 Meanwhile the government has also suggested to the Military Board the formation of a civil engineering college at Calcutta.

In 1850 Major Maitland was in Calcutta in connection, perhaps, with the conversion of his school into an engineering college was asked
to examine the possibilities of the Marine School at Kidderpore. A little later the Military Board took cognizance of the Bengal Governor's proposals for engineering education. Ultimately in 1854 the Bengal Council of Education made proposal for an Engineering department in the proposed presidency college. This having been agreed upon by the government of Bengal, the Chief Engineer put forward a proposal for the establishment of a separate college on the lines of Roorkee to which a training school for subordinates similar to Major Maitland's school might be attached. After some time, the government of India sanctioned engineering college at Calcutta, which got started in 1857.24

In the presidency of Bengal too a school of art was founded in 1854. It came out as the result of the endeavors of some gentlemen who formed themselves into an Industrial Art Society.

In Bombay presidency, in 1854 a regular school was started at Poona in anticipation of requirement of personnel for many Engineering Projects. But in 1857 the strength of the department was fixed by the Government of India at a level below expectations and the school than saw a comparative decline in its fortunes. It was transferred to control of the educational department, three scholarships were
instituted on condition that the men would repay them after securing employment with the Government. Matters in regard to engineering education in Bombay presidency stood at that for quite sometime to come.\(25\)

These broadly were the technical institutions in the country about the time of the Woods dispatch, after which a policy of extension of railway, irrigation, roads and building was embarked upon.

Growth in engineering education took place on a wider scale, and with greater consistency from 1854 onwards. Training for engineering was carried on at many different levels, college education for Assistant Engineers. Training of upper subordinates of overseer or of the foremen mechanic type, training of lower subordinate or that of the industrial artisan.

Roorkee remained a premier engineering institution in the country. From 1852 onwards men passing out found employment as assistant engineers in the Public Works Department. Later some recruitment took place from the Bengal and Madras College too. But in 1855 and again in 1859 a number of engineers of some experience were sent out from England. From 1859 started the recruitment of young
engineers who had some experience with a recognized civil engineer, by competition in England. The expansion of public works and railways that took place, however, continuously required considerable recruitment both by the Government and by the private railway companies. This could easily had led to development of engineering college on a larger scale. But under influence of various factors this did not come about with the exception of Roorkee the products of India Engineering Colleges did not, as was natural in the beginning and under handicaps of inadequate staffing and equipment satisfy the engineer officers coming from the army. They were critical not only of the proficiency acquired by Indian trained men but also of the intrinsic worth as engineers of the few Indian middle class young men who came to the engineering. They were considered to be averse to hard manual work or exertion involved in engineering as a profession. For the poor growth of Indian Engineering College were racial prejudice on the part of European army engineer offices and the tendency on the part of the secretary of state for political or the reasons to recruit engineers in England. Roorkee was a comparatively favoured institution, not withstanding these factors because of the lead it had established over other engineering colleges and because of the lead its close connections with the Public Works Department of the Government of India. But Bengal Civil Engineering college languished for relative want of
support and was in 1864 merged with the Presidency college resulting in a further weakening of the practical side of its trainings and consequent depreciation of the value of its products in the matter of employment. Poona Civil Engineering College remained for long an institution for training upper subordinates only. It too, got transferred to the control of the education department and did not therefore attain that close association with practical engineering. Upto 1864 it had only a part time principal. It was only in 1866 that a board of visitors recommended giving it more funds and staff and upgrading it to the level of training assistant engineers. Madras College became a full fledged college with a senior department only in 1861.

At Madras as well as Roorkee many army officers joined the college with a view to entering the public works department. The engineers class (first department) of these colleges consisted mostly of many officers and others of European extraction many of the later educated in Mussorie, Lucknow, etc. There were few Indians to begin with though during the sixties, as part of a policy of giving Indians more government employment, six stipends were instituted for Indian students which were fully availed of, for the first time in 1869-70.
Classes at Roorkee were small 15 men passed out as engineers in 1869-70. These people has spent two years at the college after passing an entrance test equivalent to the F.A. of the Calcutta University in 1867 30 extra engineers were advertised for and in 1868, 1850. This led authorities at home to conclude that a general engineering college of large magnitude should be opened in England or in India.28

On secretary part, Royal Indian Engineering College at Cooper's Hill was opened in 1870 with 50 students, and they were guaranteed employment in Indian Public Works Department. Meanwhile the earlier mode of recruitment under a scheme initiated by Lord Stanley (1859) began to yield less and less results perhaps because the tests had become stiffer but mainly because salaries offered were not high enough.

Regular recruitment from various sources in 1877 amounted to 18 from Royal Engineers and only 12 from Indian College. The fears thus of stagnation of Indian colleges expressed by the principal of the Roorkee College had materialized between 1863 and 1882 the Madras College had passed out 55 men from its first department qualified to be assistant engineers of these 18 found employment as assistant engineers and 27 as upper subordinates.
Meanwhile public works department was overstaffed in consequence of earlier unplanned and indiscriminate recruitment keeping only immediate needs in view without counting long term implication. The government of India now sought to get out of difficulties by urging the closure of the Cooper's Hill and retirement of earlier and less efficient people. From 1877 onwards the department had suffered from excess of engineers. The employment of 116 engineers on famine works in Madras, Bombay and Mysore took place.

Another factor which influenced the development of engineering education at this level was the pronounced policy of the government to employ India to a greater extent. In 1876 the secretary of state suggested that the European portion of the superior establishment of P.W.D. having been provided from Cooper's Hill. Only 82, out of 1013 in the Engineers (superior) establishment were Indians and of the 68 recruited in 1878 only one.

The course of training at Roorkee consisted of one year at college to be followed by apprenticeship at actual works. The Madras course like its senior counterpart was theoretical for want of facilities for practical training. Still men who passed out found little difficulty in securing appointments under the government or local boards or
railways and this tended to make the class popular with N.C.O.'s in army.  

The Government of Bengal, too opened the 'Industrial school at Dehree in Bihar in 1871 with 90 students half of whom were Indian selected out of 783 applicants. The next batch was admitted in 1879 after a competitive examination at which no Indian competed. This time a bare 12 European boys were admitted. About 1880 on the occasion of the Prince of Wales visit an industrial school of a lower order was proposed at Banlapare, Patna but the proposal to educated dilettante machines without shops came to nothing and the money continued to lie idle.'  

The question of engineering like all other technical education had been excluded from the terms of reference of the Indian Education Commission of 1882 but had been made the subject of a separate enquiry by Home Department of the Government of India.  

The review made by A.P. McDonnell of the Home Department gave the following picture of technical education in 1866:
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This gives a total of 75 institutions with 3249 students including such questionable surveying schools of Burma and Assam.

The development of technical education preparatory as well as proper as applied to industry, both indigenous and modern that followed McDonell’s memorandum and the government resolution was often confused and without a direction in instances. Policies in technical education were so often initiated by men in the education departments or others not directly in contact with most significant industries in the country viz. textiles, building, rail, road, irrigation work, jute, coal mining, tea gardens and small mechanical engineering industry. These
industries so often had their own apprenticeship or training schemes. They were generally interested in job in hand being done efficiently and felt little interest in or necessity of developing a system of technical education in the country. Even the public works department, a government agency, had little concern for the growth of engineering colleges with exceptions, to some extent, of Roorkee. Students too came from the white collar middle class which was not really interested in the trades themselves but in desk appointments with the government. Much industrial employment and apprenticeship is obtained through connections with the employer or on account of inherited family connections of the craftsmanship. The Indian middle class youth possessed neither. The rational Indian artisan was fast disappearing. The society and the economy that British rule was creating in India was weak in industry. The most powerful and looked upon to position was that of the government officials not the mechanic or the entrepreneur.

The most notable instance of technical education applied to modern industry was the Victoria Jubilee Technological Institute at Bombay. The major demand for skilled mechanical labour on a country wide scale was of course, from the P.W.D. and the railways.
In 1891 a committee was set up to investigate the requirements of the North Western Provinces. The proposal of the committee in this respect was to make a cautious beginning with a class of 12 students to be mechanical apprentices at Roorkee for three years. Chances of employment were rare because spinning and weaving mills were owned by imported men. The employers took up the attitude, “first train the boys and then we will see what we can do employ them” similar to that found at Bombay and Baroda.

A survey of industries Central Provinces in 1888-89 disclosed that industries with the exception of cotton and brass manufacturers were decaying and none were centralized enough to be assisted by any industrial school, an agricultural and an engineering class respectively were opened at Nagpur. The government also attempted to persuade the authorities of the Morris College at Nagpur to convert it into a technical institute but the Indian members on the committee did not permit this. For higher training in art or engineering Central Provinces Government instituted a number of technical scholarships to enable students of the province to study in the institution at Bombay.

In the last quarter of the nineteenth century technical education became a subject of interest in England as it was realized that Britain
was facing serious industrial competition from Germany and United States of America both of whom were much more advanced in technical education. A select committee on scientific instruction concluded that the pressure of foreign competition could be partly attributed to a failure of scientific and technical instruction in Britain. A Royal Commission on scientific and advancement of science was appointed in 1870-75 with the duke of Devonshire as Chairman. In 1881 a further Royal Commission was appointed with Sir Bernhard Samuelson as Chairman to enquire into technical education. The main argument for technical education was its contribution to industrial prosperity and efficiency.

Also Indian nationalist also started pressing for more government expenditure and facilities for technical education. They came to believe that lack of technical education was a major cause of India's economic retardation and that the Britain was deliberately denying technical training to Indians. As its third session in Madras in 1887, the Indian National Congress passed a resolution "that having regard to the poverty of the people, it is desirable that the government be moved to elaborate a system of Technical education ...." This resolution was repeated in different word year after year. There were references to "the imperative need for Technical Education" in the Congress Presidential
addresses by W.C. Bonnerji in 1892, Anand Mohan Bose in 1898, Chandavarkar in 1900 and in subsequent years also. Indian Newspapers were also continually criticizing the government for not making enough provision for technical education. The native newspapers' report for almost any year during this period and for any province contain numerous criticisms of the official policy on technical education. In 1904 an association was started in Calcutta for the advancement of the scientific and industrial education of Indians, the main object was to send students to Japan, the United States and other European countries. The National Fund and Industrial Association of Madras, and Indian Industrial Development Schemes in Bombay were also steps in this direction. An industrial conference sponsored jointly by Indian National Congress was held at Banaras in December 1905 and thereafter met every year as an adjunct of the congress. The Banaras conference suggested that the Government should establish at least one polytechnic institute for the whole of India and one technological college for each province. However, Indian business and political leadership took the initiative in advancing the study of science and technology. Later on, the leader of Swadeshi Movement in Bengal started a college for Engineering at Jadavpur.
The Simla Conference of 1901 passed several resolutions on technical education. One of them was the system of state technical scholarships. Despite the lukewarm response of local governments and the India Office, from 1904 onwards ten scholarships were awarded every year, as far as possible one scholar being chosen from each province. The object of the scholarship was to qualify the holders on returning to India to assist in promoting the improvement of existing native industries and the development of new industries, especially those which were or could be organized on a considerable scale and those in which India Capital was or could be invested. The subjects were chosen by the local governments in consultation with mercantile opinion.

The various recommendations of the Indian University Commission of 1902 to enable the British Government to control higher education in India are not strictly relevant here, some at least relating to the creation of new courses in science are important. The commission for the first time suggested the creation of the faculty of science in addition to the existing four faculties of Arts, Law, Medicine and civil engineering and suggested the following subject for the science courses:
B.Sc. Courses: one of the following groups of subjects: (1) Mathematics, Physics and Chemistry (2) Physics, Chemistry and Natural Science

M.Sc. Courses: Any one of the subjects included in the B.Sc. Course.

The commission also recommended the award of the degree of doctor of science to be given to a master of science after some years spent in original investigation. The Government Education Resolution of 1904, a few days before the passing of the Indian Universities Act, emphasized the need for the "maintenance and further development" of the technological institutes which fed the faculties of Engineering at Calcutta, Bombay and Madras.

The growth of higher technical institutions was linked to government employment and economic policies. As long as the superior services were reserved primarily for European and private services were foreign owned giving preference to foreign employees, there was not much point in encouraging Indian boys to go in for technical training. The close links between British business and officialdom and the foreign control over banking, insurance, shipping etc. was not conclusive to the growth of Indian Industries. The technical and industrial schools were in a poor condition, lacked competent direction and control, and were largely engaged in teaching carpentry
and smith work to boys who never intended to be carpenters or blacksmith. There schools failed to attract artisans' son and others because the training here was of doubtful value and employment prospect dim.

Thus progress of technical education, despite all the reports and resolutions, committees and commissions on the subject, was slow. As Curzon himself admitted, the "plant of technical education in India subsisted mainly on platitudes in viceregal and gubernatorial speeches."³⁸

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