Indian Journal of History of Science, **29**(1), 1994

THE PIONEERING ROLE OF CALCUTTA IN SCIENTIFIC AND TECHNICAL EDUCATION IN INDIA

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The paper gives a resumé of the establishment of a number of institutions in Calcutta and the important role these institutes played in the social and intellectual life of Calcutta. These are the Asiatic Society (established in 1784), the Hindu College (1817), the Serampur College (1818), School of Native Doctors (1822), Medical College (1835), three universities in Calcutta, Bombay and Madras (1857), and the Indian Association for the Cultivation of Science (1876).

By the end of the eighteenth and the beginning of the nineteenth century, India's contact with Western science and technology had begun to generate its inevitable consequences. The initial work of the Jesuit missionaries like Johann Grueber, Albert d'Orville, Nöel, Pimental, Boudier, Tieffenthaler and several others had set up isolated instances of European methodology in geography and astronomical determinations of latitudes and longitudes. These examples were further strengthened by civil and military officials and royal engineers of the East India Company. Some of them had a good training in science, engineering and/or medicine and quite a few had a sound background in mathematics. We would recall Reuben Burrow, Deane Pearse, R.H. Colebrooke, – all competent mathematicians and astronomers; Benjamin Heyne, Henry Westley Voysey, Capt. Newbold, J.D. Herbert, who pioneered geological work in this country; and similarly many others in different areas of field sciences. The scientific work of these men demonstrated the character of modern European science and scientific method and made it abundantly clear to the discerning mind that the key to European ascendancy lay in their superior modern science and technology.

The Asiatic Society, founded in Calcutta in 1784, played a double role. In the first place, the Society emphasized the strength of European science through the publication of scientific papers, memoirs and journals. Secondly, it roused national aspirations by demonstrating, through painstaking antiquarian research, the originality and excellence of ancient Indian science. The early educational thinkers and authorities were, therefore, caught between two currents of thought. According to the first school, a country which had produced such excellent literature in all branches of knowledge, including science, need not turn to the West, but should revive and adopt its own institutions and learning for educational purposes. The other school of thought, convinced of the superiority of modern European science and literature, advocated equally strongly the adoption of European science and literature for the educational and intellectual development of the people. After initial vacillations and a good deal of controversy, it is well-known, the

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second school of thought prevailed.

During the oriental period of institution-building, two institutions stand out prominently as far as scientific education is concerned. The Hindu College or the Vidyalaya, formally opened on 20 January 1817 aimed at the tuition of the sons of respectable families of Calcutta in English and Indian languages and in the literature and science of Europe and Asia. The course included, among others, grammar, writing, history, geography, astronomy, mathematics, and in time, as the funds permitted, English, *belles – lettres*, poetry, etc. For the first few years, the scientific part of the course remained only on paper due to the absence of provision for a qualified teacher. In 1823, the General Committee of Public Instruction recommended to the government the provision, at public charges, of a Professorship of Experimental Philosophy for teaching science to the students of the Hindu College and later on of the Sanskrit College. The proposal also envisaged courses in mechanics, hydrostatics, pneumatics, optics, electricity, astronomy and chemistry. For chemistry, special stress was laid on the desirability of appropriate practical classes, which meant the construction of a laboratory. One Captain Buxton, of the engineering services, prepared the plan of a laboratory estimated to cost Rs. 15,998. An enthusiastic society of London presented to the government a chest of philosophical and chemical apparatus for the proposed course. In 1824, the government also found a competent lecturer in one Mr Ross and decided to have him for the Experimental Philosophy Professorship. Eventually, but nevertheless agreed to work part-time for the college and organize the science classes. One year later, Horace Hyman Wilson reported on the success of these lectures as follows: 'The philosophical lectures have been attended with much interest, not only by the youths of the first two classes, but by a number of young men, educated in the college, and now employed in Public Offices. It is not to be expected that very precise ideas should have been gleaned from a first course of lectures on novel and abstruse subjects, but the glimpes of truth, however, imperfectly or partially caught, cannot fail to prepare the faculties for perfect vision hereafter'[1]. Wilson was, however, disappointed with the progress in mathematical teaching and recommended a more comprehensive course presented in the then well-known texts like Hutton's Mathematics and Keith's Arithmetic.

The second institution, the Serampore College, founded on 15 August 1818, by William Carey, J. Marshman and W. Ward, was equally interested in the propagation of European science through its educational programme. The original plan of the college emphasized the study of science as follows: 'In addition to this their minds should at the same time be imbued with European science and information. In doing this we must of course begin with elementary ideas, and gradually advance as the minds of youth expand .. These may be followed by views of the solar system – the principles of attraction and gravitation – the laws of motion – the nature of the mechanic powers – zoology, mineralogy, botany, etc....'[2]. Elsewhere: 'A philosophical apparatus shall be provided as soon as possible, for the sake of elucidating the various subjects on which lectures may be given; together with a museum'.

Indefatiguable Carey, despite his multifarious activities, found time to teach geology, agriculture and biological sciences and organize a fine museum where his collection of shells and mineralogical specimens, the steam engine employed by him to work his printing press, and a few other titbits could still be seen. For physical science, chemistry in particular, Ward recruited from England a youngman of the name of John Mack who had studied science at Glasgow and Edinburg and attended scientific lectures in London and Bristol. Most importantly, Mack had studied the new chemistry of Lavoisier, Davy and Priestley, which had revolutionized chemical science in the later half of the eighteenth century. During his first sea voyage to India, he learnt the Bengali language in which he later on complied his chemistry lectures under the title *Kimiya-Vidyar-Sar*. Interestingly enough, he first delivered his chemical lectures before a Calcutta audience presumably with the idea of creating an interest in the subject among the wealthy and the elite of the citizens of the capital itself to ensure success of his efforts at Serampore. As a matter of fact, Mack's Serampore lectures generated such a great interest that teachers, pandits and students from neighbouring areas and even from distant places like Calcutta and Barrackpore flocked to the Danish colony to attend these lectures. These lectures used to be enlivened by experimental demonstrations for which the College received from James Douglas of Scotland a laboratory of chemical apparatus worth £ 500. Mack also gave similar lectures on elementary geography, astronomy, mechanics and other branches of physics. His discourse on the principles of Newtonian mechanics could possibly be the first of its kind in this country.

The next important landmark was the teaching of sciences along with conventional medical subjects in the medical institutions of the first half of the 19th century. A School of Native Doctors was established in Calcutta in 1822 for the training of native doctors for the army. Four years later, medical classes were opened in the Sanskrit College to turn out Ayurvedic practitioners and in the Calcutta Madrassa to train young men in the practice of Unani medicine. At the School of Native Doctors, European medicine was the subject of instruction through the medium of Hindustani. The two early superintendents, Peter Breton and John Tytler, struggled hard to lay the foundation of Western medicine in this College. Breton prepared a vocabulary of medical terms in English and local languages, a Hindustani translation of the *London Pharmacopoeia* and several small tracts on medical and anatomical discourses and important diseases. His tracts on diseases include cholera morbus, vegetable poisons, snake venom, rheumatism and intermittent fevers. Breton's successor, John Tytler, organized his classes around the four major departments of medical science, viz Anatomy, Pharmacy, Medicine and Surgery. In Pharmacy, he laid emphasis on the study of chemistry as forming the basis of this department. His chemistry lectures covered specific gravity, latent heat, laws of affinity, principal gases connected with pharmacy, such as oxygen, hydrogen, carbon, azote, chlorine, phosphoric acid and several medicinal preparations. Tytler was fully alive to the importance of dissection in any course on anatomy and surgery, but could not go beyond zootomy, that is, animal dissection in the circumstances then prevailing. Some of the English texts which provided the materials for teaching in all these three colleges included Hooper's *Anatomists' Vade-mecum; Physicians' Vade-mecum and Surgeons' Vade-mecum, Fyfes'*

Manual of Chemistry and Conquests' *Outline of Midwifery*. At the Calcutta Sanskrit College, Pandit Madhusudan Gupta translated Hooper's *Anatomists' Vade-mecum* into Sanskrit and Bengali. Later on, he carried out similar translation work of the *London Pharmacopoeia*.

Following Macaulay's famous minute ending the controversy between the Orientalists and the Anglicists, Bentinck abolished the School of Native Doctors and the medical classes of the Sanskrit College and the Calcutta Madrassa and established, by his order dated Fort William 28, January 1835, the Medical College of Bengal for medical instruction to the youths of India 'in strict accordance with the mode adopted in Europe through the medium of the English language'. As the Medical College, born out of the controversy, was to be the showpiece of the new educational policy of the government, the College was planned on a grand scale with a Superintendent and a number of highly paid Professors of unquestionable professional attainments. Besides Superintendent M.J. Bramley, who prepared the initial scheme, the staff included H.H. Goodeve as Professor of Anatomy and Medicine, William Brooke O'Shaughnessy as Professor of Chemistry, C.C. Egerton as Professor of Surgery, Nathaniel Wallich as Professor of Botany and R. O'Shaughnessy as Demonstrator of Anatomy. David Hare was appointed Secretary of the College Council. Such a team was destined to do credit to any medical institution anywhere. It is no wonder that the Bengal Medical College soon attained international eminence and came to be described as the very best in the East. William Brooke O'Shaughnessy, who taught Materia Medica, Chemistry and Pharmacy, organized a course of natural science, including physics, which inspired the students and all lovers of natural science. He was an original scientist by his own right, developing important experiments in electrochemistry, voltaic battery, electromagnetic induction and later on telegraphy, which, in due course, laid the foundation of telegraphic service in this country. In anatomy and medicine, Goodeve was the father-figure, under whose encouragement, Madhusudan Gupta and four others (possibly Rajkrishna Dey, Umacharan Set, Dwarakanath Gupta and Nabin Chandra Mitra), rising above the deep-seated religious prejudices of the day, performed the first dissection on the human cadaver on 10 January 1836[3]. This date was given by Bethune in an address several years later. Kerr, on the other hand, gave the date of this dissection as 28 October 1835 on the basis of Bramley's first report. By 1841, the number of bodies dissected annually rose to over 500. The event of the first human dissection by the students of the Bengal Medical College is not only of great importance in the history of Western medical education in India, but was also fraught with great social consequences.

The establishment, in 1857, of the three universities at Calcutta, Bombay and Madras was expected to give a fillip to scientific and technical education, but the expectation was not fulfilled for science in general education. For the entrance examination at the Calcutta University, some provision for scientific education was at first made through subjects like natural philosophy and natural history, but these subjects were deleted from the syllabus in 1859-60. Science, of course, formed part of the course for the B.A. degree, but had to fight with the humanistic subjects for adequate representation. Mathematics course was inferior to what obtained in the pre-

University period. The chemistry course was no improvement upon what John Mack followed at the Serampore College or Giraud did at the Elphinstone in Bombay. Moreover, there was an overall deterioration in the teaching of science subjects.

In 1861, a Sub-Committee of Duff and H. Scott Smith, appointed by the Calcutta University, considered the state of science teaching in Calcutta and confirmed that most of the subjects under physical science were imperfectly taught if at all in all affiliated institutions. They reported lack of apparatus, chemicals and specimens of all descriptions and furthermore the inability of the majority of the colleges to provide for them owing to their costly nature. 'The consequence is that', concluded the Sub-Committee, 'this subject (Physical Science) which has very properly been made by the Senate a compulsory of the B.A. course, is often left to the undirected resources of the students themselves. In fact, they are left very much to the text-books, with a few or none of those aids, in the way of experimental lectures, which one considered in other countries to be essential to a proper understanding of this subject'[4]

The University's debate on the state of scientific education continued for well over a decade. In 1872, the B.A. degree course was split up into two halves: (a) the First Examination in Arts with provision for chemistry for students who desired to follow a scientific course, presumably with the object of studying at a later stage medicine of engineering, and (b) the B.A. course proper, in two groups, one for arts students proper and the other, called the 'B' course, for the students of science. The 'B' course comprised English, Mathematics, Inorganic Chemistry and another science subject from Physics, Biological Sciences, and Geology. The effect of the 'B' course (science) became visible before long. In 1879, the *Calcutta Review* recorded, 'From the report of the Calcutta Syndicate for 1878-79, it seems that the study of science, though neither enforced nor organized as well as systematically as might be, is steadily growing in favour and success. ... This is in entire harmony with the gradual progress of past years, and unmistakably shows the spontaneous movement of the young men's minds. It is further interesting to learn that the science candidates were more successful than those who went up in the other subjects; ...'[5].

Dr Mahendralal Sircar's concept of self-help in the matter of scientific education and research in the growing atmosphere of nationalism in the last quarter of the 19th century was another significant landmark. Educated in the Hindu College and one of the early graduates and M.D.s of the Calcutta Medical College, Mahendralal was a brilliant product of the English education and Western science, imbued at the same time with the ideas of the Bengal renaissance. He realized that science would never strike a deep root in this country under the tutelage of a foreign imperial power. What was needed was an institution for the generation of mass interest in science and for the training of scientists and cultivation of science by the Indians themselves under their own management. With the funds raised from the rich landlords and the elite in and around the city of Calcutta, Mahendralal established in 1876 the Indian Association for the Cultivation of Science on the model of the Royal Institution and the British Association for the Advancement of science of Great Britain. Although scientific

research was the main objective, it was a far cry throughout the 19th century. So, for the first 30 years of its existence, its main efforts were directed towards the development of scientific teaching at the collegiate level. A good laboratory was built up with instruments and apparatus procured from France; by 1878, the laboratory 'was enriched by a pretty large assortment of instruments, electrical, optical and thermotic'. In Physics, the teachers included Fathers Lafont and Peneranda of the St. Xavier's College, Dr Mahendralal Sircar himself, and, for a brief period, Jagadish Chandra Bose and Asutosh Mookerjee. Chistry lectures were delivered by Tara Prasanna Roy, Ram Chandra Dutt, Rajani Kanta Sen and Chuni Lal Bose. In Geology, Physiology and Biological Sciences, Pramatha Nath Bose volunteered to deliver lectures on Geology, Nilratan Sircar in Physiological Chemistry, Banwari Lal Chaudhuri in Biological Sciences, and Giris Chandra Bose in Botany. All these promising young men who gathered round Mahendralal Sircar and worked *gratis* to promote the Science Association movement, became prominent in later life and championed the cause of scientific and technical education in various ways. By the turn of the century, Mahendralal's Science Association at 210 Bow Bazar Street attracted young Chandrasekhar Venkata Raman to commence his scientific career. Within a span of ten years, from 1907 to 1917, Raman, by his own work and by that of his collaborators, built up an active Calcutta School of Physics that received international notice.

Dr Mahendralal Sircar's concept of self-help and nationalism in science culminated in Asutosh Mookerjee during the first quarter of the present century. Asutosh was a brilliant mathematician, with great aptitude for original scientific research, but had to opt for the profession of law in the absence of career prospects in science. He, however, made amends when he became the Vice-Chancellor of the Calcutta University. He realized the importance of university education for its own sake and opened the flood-gates of higher education despite the bogey of 'unemployed educated' and the government's efforts to restrict education. He skillfully used Curzon's educational reforms, particulary the University Act of 1904, to develop the Calcutta University into a leading institution for post-graduate studies and research by founding the University College of Science and Technology after the model of the Imperial College of Science in London and by establishing several endowed professorships and research scholarship in Physics, Chemistry, Applied Mathematics, Botany and other subjects, for which only Indians were made eligible for appointment. This was made possible by the princely endowments of Tarak Nath Palit, Rashbehary Ghose, and Kumar Guruprasad Singh of Khaira and others, the Government having withdrawn financial support when they saw that the foreigners were excluded from these appointments.

Sir Asutosh was already the leading figure in preparing the new Regulations of 1909, which provided for a thoroughly revised course for post-graduate M.A. and M.Sc. degree examinations and made obligatory the pursuance of a two-year course in an affiliated college for each candidate for the Masters' Degree. These changes generated a new enthusiasm and ambitious aspirations for post-graduate education among the brilliant graduates of the university. Acharya Prafulla Chandra Ray wrote, 'The year 1909 opened a new chapter in the history of chemical research in Bengal', because in

and around that year a brilliant group of young students joined the Presidency College either in I.Sc. or B.Sc. class. In chemistry, the group included Nil Ratan Dhar, Rasik Lall Dutta, Jnanendra Chandra Ghosh, Jnanendra Nath Mukherjee and others. The physics group had Meghnad Saha, Satyendra Nath Bose, Nikhil Ranjan Sen, Sailendra Nath Ghose, and Amaresh Chandra Chakravarti. By 1915, these young men obtained their post-graduate degrees with great distinction, so that by the time the University College of Science came into existence Asutosh Mookerjee had ready at hand some of the members of this brilliant group for starting post-graduate classes in physics, chemistry, applied mathematics and other subjects. Besides organizing classes, these young men embarked on original research work. Raman had already talked of a school of physics at Calcutta. Within a few years, P.C. Ray established an equally flourishing school of chemistry and Ganesh Prasad, Professor of Applied mathematics, unhesitatingly declared that his applied mathematics boys who had successfully gone through honours and post-graduate courses in mathematics could easily be compared to those who had been successful in the Cambridge Tripos examinations. Asutosh's great foresight and endeavours in higher studies thus signaled a great leap forward from anything known in the past anywhere in the country and served as a model to be emulated by other universities as they proceeded to organise post-graduate teaching and research.

NOTES AND REFERENCES

1. Letter dated 26 January, 1825 from H.H. Wilson to J.H Harrington, President and other members of the General Committee of Public Instruction. Correspondence Proceedings, West Bengal State Archives.
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