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SOME EMINENT INDIAN PIONEERS IN THE FIELD OF TECHNOLOGY

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The paper deals with the response of Indian technicians and craftsmen in the post 'Industrial Revolution' period of 19th and early 20th century. In Britain, 'Industrial Revolution' saw the emergence of the millwright from the tradition of village carpenters, blacksmiths and wheelwright. In fact, the millwright was the representative of a transitional stage from the traditional crafts to the modern engineer. Such giants as Watt, Trevithick or the Senior Stephenson started their career as self-taught highly skilled artisans.

The same pattern is revealed if we study the pursuits of Golukchunder, the first Indian 'engineer', Shiv Chunder Nundy of electric telegraph fame, Rajkrishna Karmakar, the Royal Engineer of Nepal, Upendrakisore Ray, who brought mathematical precision to half – tone process work and Bepin Behari Das, the first Indian to build a motor car in its entirety. None of them received any kind of formal technical education.

Introduction of engineering education, however, in no way made things easier for the Indians with talent. Actually, it crated a gulf between the illiterate 'mistry' with the traditional skill and the engineer 'babu' without any knack. The engineering courses in the British period were primarily designed for manning the Public Works Departments. The notable exceptions who succeeded in creative applications like Nilmony Mitra, the first Bengali engineer with a degree, either pursued their trade independently or sought the patronage of Indian rulers.

On 21 June, 1853 Sir C.E. Trevelyan observed before the Select Committee of the House of Lords, "Another branch of learning for which I consider that special means of instruction should be provided in the university is civil engineering, surveying and architecture. It is of the highest importance to develop the great latent resource of India, and it is impossible to do this, unless we call the Natives to our assistance in this as in other branches of our administrations. We have also entered upon an era of railroads in India, and there will be a great demand for native engineers to act under our English civil and military engineers"[1]. Three years later, a civil engineering college was established as a separate institution in Bengal, the present Bengal Engineering College, "to educate youths under twenty years of age both theoretically and practically as Civil Engineers *for the higher grades of Department of Public Works*"[2].

The first regular Engineering College of the country in a likewise manner was set up in Roorkee in 1847, which coincided with Cautley's Ganges Project and with the explicit objectives of manning Irrigation Department[3].

My paper aims at presenting sketches of some of the eminent Bengali technicians and engineers having no formal education. Their excellence provides a different kind of evidence to prove that introduction of engineering education had nothing positive to do with the people with talent and skill.

In Britain, Industrial Revolution saw the emergence of the millwright from the tradition of village carpenters, blacksmiths and wheelwright. In fact, the millwright was the representative of the transitional stage from the traditional crafts to the modern engineer. Such giants as Watt, Travithick or the senior Stephenson and many others began their carrier as self-taught highly skilled artisans.[4]

A similar pattern, however reduced in scale be it, does emerge from a study of the Indian pioneers working in an atmosphere not at all congenial. But engineering education did in no way help the Indians as it did their counter-parts in England. In fact, the system of engineering education with the motif hinted at earlier, created a gulf of difference between the illiterate 'mistry' and the 'babu' engineer. While the mistry with the traditional skill was denied the education, the engineer sought a profession tailormade by the Raj and sungly got fitted into an employment slot. There was hardly any scope for creative application for the Indian engineer.

A few notable exceptions like Nilmony Mitra, the first Bengali engineer with a degree, pursued their trade independently. We would also do well to remember that the premier college of engineering in Bengal established in 1856, turned out the first batches of mechanical and electrical engineers with full fledged degree in 1932 and 1936[5] respectively, which lie beyond the time-frame of this paper.

GOLUK CHUNDER

Goluk Chunder, a Bengali blacksmith of Titagar, can be acclaimed as the first Indian engineer if we abide by the original significance of the work 'engineer'. Engineer was a post-James Watt connotation and literally meant one who builds or erects steam engineers. And Goluk Chunder did build a steam engine in 1828.

The first self-contained industrial complex of Bengal, set up in Serampore by the famous trio of Carey, Marshman and Ward included a foundry for type making, printing presses and even a paper manufactory. Paper-making in Serampore stated from 1809, but the real breakthrough came in 1820 with the introduction of steam power[6]. The 12 horse-power steam engine of Thwaites Hick and Rothwells imported from England was an object of wonder[7].

George Smith, the biographer of Willing Carey observed: "The machine of fire as they called it, brought crowds of natives to the mission, whose curiosity fired the patience of the engineman imported to work it, while many a European who never had seen machinery driven by steam came to study and copy it, "[8]. It was no European but Goluk Chunder who did ultimately produce a prototype.

The Steam engine made by Goluk Chunder was put on display during the Annual Exhibition of the Agri-Horticultural Society hold at the Town Hall of Calcutta in January, 1828. The curious flower of iron, amidst fruits, vegetables and a dairy cow of enormous yield was awarded a special prize [9].

George Smith wrote: "In the Society's proceedings for 9th January 1828, we find this significant record: 'Resolved at the suggestion of the Rev. Dr. Carey, that permission be given to Goluk Chunder, a blacksmith of Titigurh, to exhibit a steam engine made by himself without the aid of any European artist.' At the next meeting, when 109 malees or native gardeners competed at the annual exhibition of vegetables, the steam engine was submitted and pronounced 'useful for irrigating lands made upon the model of a large steam engine belonging to the missionaries at Serampor." A premium or Rs. 50 was presented to the ingenious blacksmith as encouragement to further exertions of his industry[10].

Nothing more about the life and labours of Goluk Chunder is known. There is hardly any reason to believe that further research may unearth yet more laurels for Goluk Chunder. We will do well to remember that the Serampore paper mill, which upto 1865 competed with English paper in Asian Market as the only centre for mechanised paper-making in India, was "gradually crushed by the expensive and unsatisfactory contracts made at home by India Office"[11].

Shiv Chunder Nundy

In the age of Industrial Revolution to cope with the ever increasing need to speed up communication abreast of steamships and railways, the new science of electricity found the first practical and large scale application in telegraph. It was with the introduction of electric telegraph in India as in Britain that the profession of electrical engineering came into existence.[12]. The first Indian electrical engineer Shiv Chunder Nundy came from the field of electric telegraph.

In 1846, Nundy at the age of 22 joined the Refinery Department of Calcutta Mint. His technical aptitude came to the notice of O'Shaughnessy, the chemical examiner of the Mint and Nundy in no time became his personal assistant, the two of them together carrying out experiments in the laboratory[13].

William Brooke, O'Shaughnessy Doctor of Medicine from Edinburgh, was a Renaissance figure who joined the Medical College of Calcutta as its first professor of chemistry and materia medica around 1835. He led a dynamic life of many activities as chemical examiner and Master of the Mint, as Joint Secretary of the Asiatic Society and finally as the father of the electric telegraph in India. A series of articles published in the Journal of the Asiatic Society of Bengal and a few books and pamphlets authored by him bear ample evidence to the numerous experiments of diverse natures conducted by him in the field of electricity.

He utilized an accumulator of his own design in 1829 to explode a charge of gunpowder under water for blasting away a ship named 'Equitable' which sank near Faltah Sands, and was obstructing the passage of other vessels[14].

In 1839, the first experimental telegraph line was successfully tried in the Botanical

Gardens but O'Shaughnessy had to wait for ten more years before obtaining the approval of the Directors of the East Indian Company. In 1851, work for the 21 miles long first section was completed. A portion of the line which ran underground was unearthed during the course of some excavation carried out by the Bengal Telephone Corporation in 1827[15]. A severed metre or so of this cable can be seen in a gallery of Birla Industrial & Technological Museum, Calcutta. This cable also invokes the memory of Shiv Chunder Nundy. It was Nundy who sent the inaugural message from the Diamond Harbour and in 1851, it was received at Calcutta in the presence of Lord Dalhousie and O'Shaughnessy.[16]

Immediately afterwards, Nundy, the first Indian in the Telegraph Department, was entrusted with the instruction and training of other signallers, Nundy did yeoman's service to Telegraph Department as in-charge of construction of about 900 miles of line linking East Barrackpore with Allahabad, Benares with Mirzapur, Mirzapur with Seonee and Calcutta with Dacca. During the construction of the Calcutta-Dacca line, it became necessary to lay 7 miles of underwater cable to cross the river Padma. With no steamer company willing to land their vessels for the work at less than ten thousand rupees, an exasperated Nundy got it done by hiring country fishing boats. Hemendra Prasad Ghoshe's tribute to Nundy published in 'Basaumati' contains many details about the life and heroic deeds of this mean.[17].

There are some beautifully executed coloured lithographic reproduction of the drawing of telegraph posts, innovated by Nundy, in the possession of National Archives, Delhi. These drawings, along with an accompanying letter which he sent to O'Shaughnessy on 30th September 1855,[18] are sufficient to secure for Nundy the distinction of an engineer proper, one, who in his ability to make creative application can only distinguish himself from the repetitive pursuits of mechanic.

The years in which Nundy wrote the letter, also saw the publication of the first treatise of the electric telegraph in Bengali by Kalidas Moitra of Serampore. Though the English sub-title humbly offered it as 'The telegraph office assistants' manual, there is little doubt that the author had first hand knowledge about the progress of work in India. Moitra even put forward his proposal for sending messages in Bengali. The book contains a chart illustrating the Bengali keyboard as an alterative arrangement[19].

KALIDAS SEAL

Skipping some intervening years the story is resumed from the age of electric generation by dynamo machine. Contrary to general belief, electricity for the purpose of lighting came to Calcutta at least twenty years before the first electric generator of the Calcutta Electric Supply Corporation was turned on in 1899. In the pre – CESE days, electric lamps meant carbon arc lamps. They were rather formidable. ("The hissing noise of the electric light in a quiet room is simply unbearable")[20]. To maintain a constant gap between the eroding tips of the two arc-forming carbon rods, many kinds of regulators were designed. The regulators mostly depended upon movements

controlled by automatically produced electromagnetic actions as the distance between the carbons changed. All the major manufacturers of arc lamps, Serrin, Siemens, Brush and Edison etc. produced more than one form of regulators. Siemens for instance patented at least eight of them. [21] A little acquaintance with the carbon arc lamp is necessary for a proper appreciation of a Bengali firm of electrical engineering which made its debut in the age of the hissing lights.

The Statesman on 30 January 1885 and on 1 February 1885 observed a novelty in the form of electric light which was employed by a marriage procession at night. The light used in the procession in Chitpore Road, a "Serrin" 1500 candle-power, was "very powerful, brilliant and steady, and the illumination was so successful that a man could see distinctly objects at considerable distances." The newspaper did not forget to mention that "the electrician who arranged the apparatus is a rising young member of Scientific Bengal, Mr. Sil, of the firm of Dey, Sil & Co." On 5 February, 1988, the same paper reported that the firm had applied electric lighting "to the chotoordollah (nupital car) of a marriage procession, on the occasion of the nuptials of one of the Mullick family at Pathuriaghatta". Advertising as "Electricians, Electro-metallurgists and Brass Founders", they were located at 36, Wellington Street.

The same firm made their presence felt at the evening party given by the Indian Club on 28 December 1886 in honour of the delegates of the Second National Congress held at Calcutta. Among the guests was Rabindranath Tagore, who "very kindly sang a few excellent songs of his own composition assisted by a strong chorus." Dey, Sil & Co., on the occasion illuminated the place with electric light and also exhibited electric apparatus of their own manufacture which were much admired by Father Lafont and Mr Elliot, Professor of Physical Science, Presidency College.[22]

As part of the Jubilee rejoicings of Queen Victoria, when Calcutta was illuminated on 17 February 1887, the residence of the Maharaja of Durbhanga was lit by electricity by the same firm. It is interesting to note that even Governor's House was not lit by electricity at the time [23].

At the annual Conversazione of the Mahomadan Literary Society held in the Town Hall on 27 January 1888, the Company exhibited carriage electric lamps, lighted by "Stored currents from accumulators" of their own make. They also exhibited sowing machines and table fans worked by electromotors, which were highly admired and Lord Dufferin "had a conversation with the manufacturer, and congratulated him on his ingenuity"[24].

The firm was in existence even in 1912. But it was shifted to the residence of its managing proprietor, Kalidas Seal at 6 Sagar Dhur Lane [25].

RAJAKRISHNA KARMAKAR

The next luminary in this 'Hall of Unknown Fame' is Capt. Rajakrishna Karmakar.

Let me admit at the first opportunity that all my information is borrowed from a single source, 'Banger Bahire Bangali' by Jnanendramohan Das, a stupendous mine of informations about eminent immigrant Bengali [26].

Rajakrishna was still alive when Jnanendramohan's work was published in 1915 and it is obvious that the author was either in direct communication with him or had access to first hand information.

Rajakrishna was born in 1828 in Dafarpur of Howrah. His father Madhav Chandra, a village blacksmith could not even sustain his school education. Rajakrishna as a lad of 14 years, found the first admirer in his employer, the engineer-cum-manager of Ganges Company of Howarah, who sent him on many errands requiring ingenuity. He next found employment with Government Surveying and Mathematical Instrument Dept., where he was engaged in fabricating surveying instruments like theodolities. He left his next job with East Indian Railway Locomotive Department to found a flour mill at Salkea. With the failure of the mill, he subsequently found employment one after another in Calcutta Mint, Waterworks at Palta, Jute Mill of Ghusuri and Bally Paper Mill. With the object of learning gun and ammunition making he first joined Govt. Gun Foundry at Cossipore and then Government Cartridge & Bullet factory at Dumdum as the head mechanic.

In 1869, at a monthly salary of Rs. 150 he joined the service of the Government of Nepal and left for that country accompanied by five assistants -Shymacharan Karmakar, Digamber Chandra Laskar, Girish Chandra Kansari, Kailash Chandra Ghosh and Jadunath Nundy. His first job with the Mint saw introduction of machine forged coins in Nepal. On his transfer to the ammunition factory, he set up a water-wheel to provide motive power for the manufacturing processes. A few years after the death of Maharaja Chandra Samser Jung, he came back to India in 1880.

After trying his hand at independent business and various small jobs, he want to Kabool with 12 mechanics at a monthly salary of 200 rupees. A few miles away from Kabul in a place called Baburbagh, he set up three factories within a span of six months. The machineries for these gun and ammunition factories were obtained from Walter Locke & Co. For the benefit of the Ameer of Kabul, Rajakrishna laid a small railway line from the Durbar to the factory and a five horse power engine was employed for locomotion.

After the expiry of a two and a half years' contract Rajakrishna on his return found a fresh invitation from Maharaja Vir Samser Jung of Nepal. He left for Nepal in 1884 with two of his Kabul companions, Jadunath Nundy and Adharchandra Karmakar. The new gun factory and wood-working works set up by him earned him the title of Captain and a valuable and ornamental decoration in the form of a 'pugri'. Of all the foreigners employed in Nepal, he was the first to be conferred with a regular title of the Nepal Government.

After working for two years, he enjoyed a leave of two months and on his return lit the first electric lights of Nepal. Jnanendramohan observed that at the time of his writing (around 1915) the dynamo installed by Rajakrishan was still in existence in a dilapidated condition in the palace of the Maharaja. He also succeeded in manufacture of machine guns and after his retirement settled in Nepal at a place near Baghmati river.

UPENDRAKISORE RAY

As writer, illustrator, painter and even as musician, Upendrakisore needs no introduction for the Bengalis. But in the West, Upendrakisore in his own life-time won acclaim as a first ranking scientific worker who brought mathematical precision to the process camera work, which in our popular parlance has taken the form of 'inventor of the half-tone block'. He certainly did not introduce half-tone blockmaking in India let alone its invention. But this revelation similar to the debunking of the Apple-Newton myth does not find the genius poor even by a shade.

In 1895, Upendrakisore, a self-taught man, founded his firm of half-tone blockmaking and bromide enlargements[27]. In the course of time, U.Ray & Sons emerged also as printing house of distinction[28]. 'Sandesh', the proverbial magazine for the children in Bengali founded by Upendrakisore could also be considered as the house journal of the firm illustrating their skill and ingenuity[29].

Between 1897 and 1911-12, Upendrakisore contributed nine research articles for Penrose's pictorial annual published from England and considered to be the printers' 'Bible of the time. Process camera differs from an ordinary camera primarily on account of incorporating a screen with opaque ruling which breaks up the original picture into a conglomeration of dots in the negative. Upendrakisore made use of diffraction, a little understood phenomenon of physics, to obtain half-tone negatives having dots twice or quadruple in number to that of the screen lines. A proper understanding of the diffraction principle also first enabled him to make direct half-tone negatives of three dimensional objects [30].

Upendrakisore also invented an equipment for automatic adjustment of the screen in the process camera. It was used to be sold as an attachment of process camera of Penrose make.

Upendrakisore was the first to point out theoretically two completely different kinds of screens, namely, a sixty degree screen and a three line screen. One Mr Schulze got one such 60° screen made after the publication of the relevant paper by Ray and took a patent for it. The penrose editor, Mr. Gamble, a great admirer of the 'classical pen' of Ray, admitted "Mr. Ray is able to prove that he anticipated by some years the 60° screen...."[32]. Upendrakisore, referring to this unethical act, in his subsequent article in the Penrose made a memorable comment: "to the craft it matters little who get the credit for a particular invention. What directly concerns them is the addition of a

valuable resource to their equipment"[33].

Introduction of Multiple Diaphrams was another major contribution by Ray. In process-work multiple exposures are sometimes given to the same negative using different aperture and speeds. The apertures differed in size only, the shape being the same, circular. Upendrakisore mathematically determined how an aperture' plate with multiple perforations of different shapes and sizes could be made, so that one exposure could suffice[34]. He made the process camera work like an ordinary camera in the sense that a single pressing of the shutter was enough for securing the image.

The firm of U. Ray & Sons were the originator of the chain reaction which led to half-tone blackmaking in Calcutta taking the shape of a cottage industry. The wood-blackmakers thrown out of their trade with the advent of half-tone were soon found to be outnumbered by the half-tone workers[35].

H. Bose

Hemenandramohan Bose, better known as H. Bose, was the first successful manufacturing perfumer of India. Kuntalin, a hair oil, the perfume Delkhos, many kinds of fruit syrups, and hair wash – all of his products won a big market. Tambulin, in a way was years ahead of the present Pan-paarag class[36]. Bose was also the first to turn out indigenous voice recordings on a commercial scale in India. He founded the phonographic business in 1905. 'The Talking Machine Hall', as it was named, was situated in Marble House at 41, Dharmatala Street[37].

In early 1906, at the peak of the anit-partition agitition, the first batch of phonographic records, the so-called cylinder records were offered for sale[38]. Labelled as H.Bose's Records, all of them were patriotic songs and sung by none other than Rabindranath Tagore, Dwijendralal Roy and Kaliprasanna Kabyabisarad. No less than sixteen songs of Rabindranath including such all time favourites like 'Sarthak Janama Amar', Ebar tor mara ganga', O amar deser mati' or 'Aji Bangla deser hriday hote' were available as H. Bose's Records.

In the Indian Industrial Exhibition of Calcutta held in 1906, H. Bose's phonographic record was awarded a gold medal on the recommendation of Prof. Jagadis Chandra Bose, the official judge [39].

With the advent of the disc record, H. Bose felt the necessity of switching over from the cumbersome cylinders. He got into a partnership with the famous French firm of 'Pathe' and got many of his cylinders transferred into discs bearing the lable, Pathe-H. Bose's Record[40]. One such record, containing the recitation of 'Sonar Tari' on one side and the song 'Bande Mataram' on the other is the oldest existing voice recording of Rabindranath Tagore. It is worth noting that after the H. Bose connection, Tagore did no more recordings for almost 15 years. His first recording with Gramophone Company coincided with the introduction of the electrical amplification system.

PRASANNA KUMAR GHOSH AND BEPIN BEHARI DAS

'Sulabh Samachar' in 1871 noted that about two years ago a kind of two and three wheeled cars arrived in Calcutta which could be propelled by gesticulation of legs, obviously meaning, pedalling,[41]. It is also on record that around 1867-68, the Maharaja of Burdwan imported a velocipede [42]. But more important and astonishing too is the following report which was published in the above-mentioned paper a year before, "Many of us must have seen that there is a kind of three-wheeled vehicle in Calcutta which is not drawn by horses. The rider himself is required to exert pressure by his legs and that makes it run faster than a horse-carriage. Recently, a blacksmith of Santragachi according to his own idea prepared a vehicle of similar kind. In this vehicle one person at the front and two at the rear make the wheels rotate by their legs and the vehicle moving on its own"[43].

Obviously, the report was referring to a cycle which is technically known as the tandem type. A few weeks later 'Sulabh Samachar' further added that a man named Prasanna Kumar Ghosh was its manufacturer[44]. This is all that we know about the first Indian manufacturer of a cycle.

When motor cars started to make their presence felt at the turn of the century, the famous coach-builders of the day like Steuart & Co. or Dykes & Co. of Calcutta found little difficulty in reorienting their expertise and built elegant car-bodies. In the 1920's, Russa Engineering Co. produced light Russa cars with Ford engines [45].

The first motor car built in it entirely by an Indian was named 'Swadeshi' by its designer and manufacturer Bepin Behari Das. Bepin Behari, a self – taught mechanic working in a small shed near ballygunge Phari (Ballygunge-Bondel Road crossing) built all the components of the cars including its body and chasis except for tyres, spark plugs, carburettor and magneto, 'Swadeshi' was a 15 hp L-head 4 cylinder 5 seater and 4 door touring model car[46].

Das sold his first car to Benares Hindu University in 1931. D.P. Khaitan, a councillor in Calcutta Corporation noted in 1933 that the car was still on the road, had already run for more than two years and was used by Pandit Motilal Nehru and Pandit Madan Mohan Halviya [47].

Calcutta Corporation entrusted Das the task of building a second car for them at a cost of Rs. 3000/-. Arrangement were made to pay him Rs. 300/- per month as advance for six months. It is interesting to note that when the delivery of the car was a little delayed almost all the councillors expressed serious doubts regarding the capability of Das and were certain of misuse of public money. Among the doubtful were Hon'ble B.K. Basu, Sushil Ch. Sen, F. Rooney, Bhupendranath Banerjee, Khan Bahadur Abdul Momin, P.N. Guha and Prof. S.C. Ghosh. Das was supported in his venture by the mayor Santosh Kr. Basu, D.P. Khaitan, N.C. Paul, Chairman of the works Standing Committee and J.C. Gupta, Motor Vehicle Superintendent of the Corporation.[45].

After the first trial run of the 'Swadeshi' in Calcutta in November 1933, the motoring editor of 'Advance' wrote, 'last week an event, which will perhaps stand out as epoch-making in Indian industrial history, took place, comparatively quietly when the first motor car manufactured in Bengal by a Bengali, was passed by the police for registration and awarded the number 35977. " The car did upto 35 mph and the ease in steering and its good acceleration were praised by the correspondent [49].

But Das's endeavour found little appreciation and no financial backing. He built another car in Gwalior State which ran satisfactorily for many years. He was engaged upon another venture in Calcutta at the time of his death in 1938. He was only 55. A perfunctory obituary in the Municipal Gazette conclude with, 'He was undoubtedly justified in his claim to have been the only Indian manufacturer of a car in this country'[50].

NILMONY MITRA

The tercentenary celebration of Calcutta have unfortunately taken the shape of simply harping on an all-British tune. There is no wonder that it is the European buildings which have kept the painters and photographers equally busy while scholars are engaged in deciphering the styles of architecture – the diminutive Gothic, Roman, Doric, Palladian etc. But unnoticed, in this city of palaces still exist a few nineteenth century edifices which speak eloquently for their architect, Nilmony Mitra, who in spite of his English schooling borrowed heavily from the Indian heritage to produce a Hindu-Muslim mix.

It is worth quoting in full the obituary published in the Indian Mirror after his death on 24 August, 1894, at the age of 69, "During his college career, his extraordinary attainment in Mathematics, induced the Rev. Dr. Duff to exert all his influence with Sir Henry Lawrence, the then Lieutenant Governor of the North – Western Provinces, to allow this first Bengali gentleman to enter Thomason Civil Engineering College in 1851 at Rurki, and he more than justified Dr Duff's expectations by heading the list in every examination and carrying off all the highest prizes. Specially recommended by Major Oldfield, the then Principal, he joined the public service at Calcutta and after five or six years of distinguished career, he retired from the service, determined, as he said, to open out an independent line for men of his profession in Bengal, and he succeeded. Simple and unostentatious, strong in his principles and an upright and conscientious man, loved and respected by all, he rose to be one of the most distinguished men of Calcutta. He was an authority in his line, and was often consulted not only by Municipal Corporations, but sometimes by Government officials. He had an unparalleled genius for Indian architecture, and devoted his life to its development, and many noble buildings, in and out of Calcutta, are his living monuments. Thus, through his exertion and personal sacrifices, Madhpur has risen to be the beautiful sanatorium it now is. Besides his professional duties, he had to discharge others, no less arduous, as a respected citizen; and he discharged them all, conscientiously and to the satisfaction of all. He was a fellow of the Calcutta University, and Honorary Magistrate of the 24

– Parganas and of Dum dum and also for some years a Commissioner of the Calcutta Corporation'[51].

The impressive list of Mitra's creations includes Pashupati Bose's house in Baghbazar, renovation of the 'Belgachia Villa' along with the addition of a zenana mahal, Belgachia School building, house of Metropolitan Institution established by Vidyasagar, the first building of the Cultivation of Science at Banbazar street, Kirti Chandra Mitra's house in Mohanbagan, the palace of Jatindramohan Tagore and 'Emerald Bower', the Ratan Lodge at Chandernagor and the Narendranath Dutta Memorial Bathing Ghat at Panihati. The famous iron chariot of Mahesh was also built according to his design. The plan for the Sadharan Brahma Samaj Temple was also drawn by him though he never embraced Brahmaism. He was the first to built public bathing houses for ladies and gentlemen of Calcutta at Shyam Square in 1883[52]. 'Battala' was the first house built by him in 1888 in Madhupur. Subsequently he built 'Kantaltala' and a few more which are remarkable for their simplicity and functional design.

On 26 January 1895, Alfred Croft, Vice-Chancellor of Calcutta University, in his convocation address paying homage to the deceased said, "To the residents of Calcutta, it may be said *si monumentum requires, circumspice* (if you seek his monument look around you). The mansions of many of the wealthy inhabitants of Calcutta and other important buildings of public character, bear witness to the originality and success of his ideas"[53].

The descendants of Nilmony Mitra in their ancestral home are justly proud of an oil painting of their great grandfather. A compass is seen to be held by Mitra in the painting. The compass is also preserved with other components of the historical instrument box.

In conclusion, I would like to add that it would be wrong to assume that the few persons dealt with in this paper were the only examples of creative talent in the field of technology in Bengal. Panchanan, Manohar and Krishnachandra belonging to the three generations of the Karmakar family, the pioneer Bengali type makers and founders; Sitanath Ghosh, who taught the young Rabindranath Tagore physical science and manufacturer of an air pump and power loom, exhibited in Hindu Mela in 1870[54]; Mahendranath Nundy, ridiculed by Rabindranath as a match manufacturer but succeeding with the founding of Govind Match Factory in Narayanganj, Dacca[55]; Devendranarayan Basak who ran an oil mill by steam in 1877[56]; Prankrishna Mukherjee, the inventor of a rope making machinery in 1884[57]; Kalicharan Basu, manufacturer of biscuit making machineries in 1885[58]; Jagadishwar Ghatak, inventor of water cycle boat in 1885[59]; paddy husking mill[60] and punkah pulling machinery in 1895-96[61]; Pundit Kedarnath Chakraborty, inventor of the 'Easy Printer' who was granted a patent for it in 1901[62]; Ganadev Ganguly of Remington Co., manufacturer of a Bengali typewriter in 1906-1907[63]; Benerjee & Co., builder of steam launch in 1906[64]; R.K. Das, the maker of Bed-room fan in the same year[65]; and A.M. Dastur and C.C. Ghosh, makers

of McCarthy type Gin (granted with U.K. Patent No. 13488, 1902)[66] – all of these inventors, innovators and manufacturers and many more require individual attention. Resurrecting the biographical details of Malek, Jamshed, Barik and Putiram, the Indian technicians employed by Jagadish Chandra Bose, the great experimental physicist, to build his instruments, still remain to be undertaken.

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