

# Science and domination: India before and after independence

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*The colonial overseas British empire was made possible by (modern) science in two ways. First, science provided the physical means of acquisition of territory and its control. Second, the development of the powerful intellectual system of modern science gave Europe a cultural and ethnic superiority -which in turn provided legitimacy for the colonial rule. From 1869 till, say, 1914 the Indian upper class made conscientious efforts to cultivate pure science with a view to countering the ideological domination by the British. As a corollary, the role of science as a new means of production of wealth was largely ignored. Independent India's attitude towards science has been fashioned by its colonial experience. Under the Indian auspices, modern science was Brahminized during the colonial period, and Kshatriya-ized after independence. The artisanization of modern science that gave Europe its strength never took place in India.*

All knowledge systems have been used as tools of domination. What sets modern science apart is the fact that domination over nature and over culturally and ethnically different people has been inbuilt into its very advent and growth. When in the early decades of the 15th century, Europe, as represented by Spain and Portugal, set out to explore the African coast with a view to reaching the spice-rich India without encountering the 'belt of Islam', it had no worthwhile scientific tradition of its own. The knowledge input for the early voyages came from the Jews who knew calendar-oriented theoretical astronomy and the Moors who knew the sea.

The profitability of these voyages transformed the European economy and mindset for all times to come. Prosperity no longer depended on the goodwill of the god or the king but on one's ability to go to sea and come back alive. Industrial arts and sciences grew hand in hand with European maritime trade and colonialism till modern science itself was formalized in the early 19th century. Science-given prosperity created a Europe that could support, sustain, appreciate and flaunt science as an intellectual accomplishment.<sup>1</sup>

In the early days of maritime activity when scurvy and longitude took their toll, nature was viewed as an enemy to be subdued. The natives of the newly 'discovered' lands were brought back as a trophy to be displayed and a commodity to be marketed. The spirit of the times is well captured in the writings of the English nobleman Francis Bacon (1561-1626) whose long-lasting influence as a philosopher of science has overshadowed the memories of his career as a disgraced politician and judge. As a prophet of science Bacon held that nature should be made 'to serve the business and conveniences of man'. More brazenly he declared<sup>2</sup>: I am come in very truth leading to you

Nature with all her children to bind her to your service and make her your slave'. The imagery employed here is significant. May be, by talking of nature and her children. Bacon was trying to keep the European explorers physically away from the native women they would encounter when they ventured out. But, clearly, when Bacon mentions the enslavement of nature and of human beings in the same breadth, he is using one to justify and support the other, in the name of advancement of science.

Modern science gave Europe the physical means of subjugating and colonizing the rest of the world, and in the case of the old world the ideological justification for the exercise: any culture that could develop the powerful knowledge system of modern science was culturally and racially superior and therefore entitled to rule.

The extended exercises in ideological justification have since been named orientalism. Generalizing from Edward Said's seminal, but area-specific, Analysis<sup>3</sup>, we may define orientalism as an ideological and operational paradigm consciously created by the west to define and describe the east in such a manner as to facilitate and justify its control by the west<sup>4</sup>. Orientalization of the east began with giving absolute meanings to relative geographical terms east and west. Orientalism, however, was not a monolith. It took different forms in different parts of the east depending on the local characteristics and the nature of historical encounters with Europe.

In Hindi and other Indian languages the word for European is Firangi, derived from Frank. Now, of all the European countries why should France have come to represent the continent? The answer is very instructive. The word Firangi came to India with the Muslims for whom the Europeans

were the same as the Christian crusaders, known collectively as Franks. This brings home two important points. First, the mutual relationship between the Europeans and the Muslims was fashioned by the memories of past confrontations. Second, in contrast, the relationship of the British with the (upper-caste) Hindus began without any preconceived notions and was cemented by the early discovery of Indo-European commonality. Orientalism in the Islamic world was confrontationalist. On the other hand orientalism in India was persuasive and seductive. It took the form of Indo-Europeanism, and was nurtured by the Asiatic Society type of research carried out in India and Europe.

### **Brahminization of science**

Paradoxical as it may seem, inherent in the British rule over India was the slow and increasingly reluctant preparation of the Indians to eventually overthrow the British rule. In December 1823, Rammohun Roy (1774-1833), the leader of the new, post-Plassey (1757), Calcutta-based Indian middle class, sent a memorandum to the governor-general advocating English education in preference to 'the Sangsrit system of education'. More specifically he pleaded that for the sake of 'the improvement of the native population' it be given 'a more liberal and enlightened system of instruction, embracing mathematics, nature philosophy, chemistry and anatomy, with other useful sciences ... by employing a few gentlemen of talents and learning educated in Europe'. Roy's memorandum remained unanswered<sup>5</sup>. Twelve years later, following Thomas Babington Macaulay's (1800-59) minute, Sanskrit was abandoned and literary English education officially introduced for the natives.

In 1817 a Hindu College (which began as a school) was set up in Calcutta for 'the tuition of the sons of respectable Hindoos'. It was left to a Scottish-born watchmaker and silversmith of Calcutta, David Hare (1775-1842), to seek to swell the ranks of respectable Hindus through the vehicle of education. At what later came to be known as Hare's School, poor boys were given free tuition and later merit scholarships to join the Hindu College. Derisively called Boreahs by their well-heeled classmates, 'these pupils invariably proved the most distinguished and ... carried almost all the honours', turning the college into 'a mighty instrument for improving and elevating the Hindoos'<sup>6</sup>.

One such Boreah was Mahendralal Sircar (1833-1904), who transferred from the Hindu

College to the medical college, the only place then where one could study any science. An M.D. turned-homeopath, he sought to induct modern science as a parameter in the collective consciousness of the Indian middle class. Through his sustained efforts<sup>7</sup>, an Indian Association for the Cultivation of Science (IACS) was set up in 1876 at Calcutta as a companion organization to the political Indian Association, which became the precursor of the Indian National Congress. A discussion of the history of IACS is often coloured by the fact that 50 years later it became the venue for Chandrasekhara Venkata Raman's (1888-1970) Nobel prize-winning experiments. It would be instructive to examine the 'philosophy' behind the establishment of IACS, especially because it has had a bearing on the pursuit of modern science by the Indian ever since.

The Aryan race theory, popularized by Max Muller and others, was accepted as the basic ideological framework by the Indian middle class for formulating its relationship with the British<sup>8</sup>. In March 1877, the influential Brahma leader Keshub Chunder Sen (1838-84) in a public address exhorted Indians to be loyal to Queen Victoria, the Empress of India. He reminded his 'educated countrymen' that it was the 'British government that came to your rescue, as God's ambassador, when your country was sunk in ignorance and superstition and hopeless jejuneness, and has since lifted you to your present high position'. Sen continued: India in her present fallen condition seems destined to sit at the feet of England for many long years to learn Western art and science ... Thus while we learn modern science from England, England learns ancient wisdom from India.' Sen went on to declare with flourish: 'Gentlemen, in the advent of the English nation in India we see a re-union of parted cousins, the descendants of two different families of the ancient Aryan race.'<sup>9</sup>

In the far-off South Africa, in 1894 Mohandas Karamchand Gandhi (1869- 1948), the general secretary of the newly established Natal Indian Congress addressed an open letter<sup>10</sup> to the members of the legislature. A copy of this letter was circulated among the Natal-based Europeans, 'whether you be a clergyman, editor, public man, merchant or lawyer,' with a view to removing 'the prevalent ignorance about the Indians in the Colony', in the belief that 'one half, or even three-fourths, of the hardships entailed upon the Indians in South Africa result from want of information about India'.

In the open letter, Gandhi dwelt at length on the question: 'What are they [the Indians]?' Calling it

'the most important' 'head of the enquiry', he requested the readers to 'peruse it carefully'. At the outset Gandhi declared: I venture to point out that both the English and the Indians spring from a common stock, called the Indo-Aryan'. In support of the above', he quoted W. W. Hunter, 'the learned author of the Indian Empire': 'This nobler race (meaning the early Aryans) belonged to the Aryan or Indo-Germanic stock, from which the Brahman, the Rajput, and the Englishman alike descended ... when we first catch a sight of ancient England, we see an Aryan settlement, fishing in wattle canoes and working the mines of Cornwall.'

Gandhi then gave 'copious extracts, which will show at once that the Indians were, and are, in no way inferior to their Anglo-Saxon brethren'. The extracts were taken from a variety of European authors such as Max Muller, 'the German philosopher Schopenhauer', H. S. Maine, Andrew Carnegie, Pincott, Goethe, Bishop Heber, Thomas Munro, George Birdwood, C. Trevelyan, and Victor Hugo. Self-satisfied, Gandhi concluded: 'Such is India'. In his enthusiasm, Gandhi went for an overkill. He asserted that 'The Institutes of Manu have always been noted for their justice and precision', and, quoting H. S. Maine, called them 'an ideal picture of that which, in the view of the Brahmins, ought to be the law'. By this 'somewhat overdrawn or fanciful ... but nonetheless faithful' picture, Gandhi hoped 'to induce you [the Europeans] to believe that India is not Africa, and that it is a civilized country in the truest sense of the term civilization [italicized in original]'

Even though this was written more than a year after Gandhi had been thrown out of the first class train compartment, intellectually he was still a product of the colonial historiography. Indeed his transformation from Mohandas Gandhi to Mahatma Gandhi came about when he conscientiously jettisoned the baggage of Indo-Europeanism and strove to put modern European civilization on the defensive on moral and ethical grounds<sup>11</sup>.

As late as 1922, in an essay entitled 'The acoustical knowledge of the ancient Hindus', Raman wrote<sup>12</sup>: It would form a fascinating chapter of history to try and trace the gradual development of musical instruments and musical knowledge, from the rhythmic chanting of the Rigveda in the ancient home of the Aryan race to the Indian music of the present day.' This statement is made in passing and is not central to Raman's essay. It shows that the Aryan commonality was accepted as a general well-established background information.

Sircar is the first Indian to make use of the Aryan theory. He might have learnt about it from the reports of the British Association for the Advancement of Science of which he was a life member or from the Calcutta press, which wrote on the topic. In December 1869 he published an article in his own Calcutta Journal of Medicine (the issue is nominally dated August) entitled 'On the desirability of a national institution for the cultivation of the Sciences by the Natives of India'. This important document also published separately as a pamphlet, has been quoted selectively. It does not seem to have received the attention it deserves, although later documents pertaining to IACS have been much discussed and even reprinted. recently.

Sircar's diagnosis of the native condition would have met with Max Muller's approval. Sircar wrote<sup>13</sup>: 'The Hindu mind, thanks to this religion which has been swaying it for centuries without number, and thanks no less to its other surroundings, has lost much of its original Aryan vigor and energy.' He had a remedy: 'the only method... by which the people of India can be essentially improved, by which the Hindu mind can be developed to its full proportions is ... by the cultivation of the Physical Sciences'.

In this enterprise. Sircar expected help from the British community, on grounds of noblesse oblige: '... thanks to the current of inherent generosity that flows through every British heart, some obstacle or other is being removed, that stood in the way of our being recognized as brethren, though now fallen and degraded'. 'She [England] has become aware that her true glory should consist not in simply holding under subjugation the people of India, but in elevating them in the scale of nations, in taking them by the hand and reconciling them to their long-alienated brethren, her own children'.

The 'fallen and degraded' brethren had been receiving help. At the setting up of the Hindu College, three persons had played an influential role: an Indian (Rammohun Roy), a non-official European (David Hare) and a high-ranking British official (the chief justice of the Calcutta supreme court, Edward Hyde East (1764-1847)). The same pattern was repeated in the case of IACS, the trinity this time being Sircar; the Belgian Jesuit physics professor, Eugene Lafont (1837-1908); and the lieutenant-governor of Bengal, Richard Temple (1826-1902). It is a measure of the changing times that, unlike the chief justice three decades previously, the lieutenant-governor was a reluctant supporter, brought around by the native opinion.

In May 1875, Temple wrote to Sircar suggesting the setting up of what would be called a polytechnic today. He said<sup>14</sup>: 'But science also may be made to add immeasurably to the national wealth and so' to afford lucrative employment to numberless persons according to their qualifications and acquirements'. He then listed a large number of occupations for which training could be imparted, including those of land and geological surveyors, civil engineers, trained mechanics, foresters, engravers, wood and stone carvers. He then went on to say: 'Moreover, by these means not only will many new industries be introduced into Bengal, but almost every one of the old established art, and manufacturers of the country may be rendered more useful and remunerative than at present.'

Today this prescription dated 1875 would be called a blueprint for the modernization of rural India. But at that time it did not meet with the native approval. Three months previously, the lieutenant-governor had sent a letter to the viceroy on the rising discontent in India. In this, Temple lamented<sup>15</sup>: 'But this arises partly from our higher education being too much in the direction of law, public administration, and prose literature,' where they may possibly imagine, however erroneously, that they may approach to competition with us'. Temple had a solution to offer: 'But we shall do more and more to direct their thoughts towards practical science, where they must inevitably feel their utter inferiority to us'.

If Temple had had a means of addressing the vast Indian artisan castes that had been pauperized as a consequence of the industrial revolution in Europe, they would perhaps have accepted Temple's offer of useful employment and the concomitant 'utter inferiority to the Europeans'. But the Indian middle class was made up of castes traditionally not associated with manufacture. The British rule had in fact brought the Brahmins back on centre stage and elevated the status of the non-Brahmins in Bengal and elsewhere by giving them equal share in the inheritance of ancient learning. Thus, Babu Rajendralala Mitra (later the first Indian president of the Asiatic Society, Calcutta), a Kayasth by caste and a newly listed member, of the Vedic-dub, could declare proudly<sup>16</sup> (as reported in third person): 'For three thousand years and upwards their [Mitra et al.'s] ancestors had cherished Sanskrit learning for its own sake, and need it be doubted that their descendents would not be equal to the sciences of the present day'. Temple's practical science was not acceptable.

Mitra warned: 'do not ... attempt to make it [the proposed institute] self-supporting by producing

remunerative art work in your laboratories. If you do, you will disappoint your pupils, and court signal failure'. Mitra could speak with some confidence on that subject. He had taken a prominent part in the founding of the Calcutta School of Industrial Arts ... 'and he knew well that as often as he tried to produce remunerative work, he demoralized the pupils of the school'<sup>17</sup>. At the public meeting chaired by Temple, Eugene Lafont is recorded as having declared that 'the other Association'<sup>18</sup> [pro-Temple] wanted ... to transform the Hindus into a nation of mechanics, requiring forever European supervision, whereas Sircar's object was to emancipate, in the long run, his countrymen from this humiliating bondage'. (In retrospect things have net turned out the way they were anticipated Pure science which started as an emancipating activity became more and more derivative with the passage of time. On the other hand, if India had agreed to serve as mechanics under European supervision to begin with, it is very likely that it would have emerged as an independent industrial culture in course of time.)

IACS was instrumental in getting science included in the college curriculum, although pure scientific research by the Indians themselves began only with the return of Jagadis Chunder Bose (1858- 1937) and Prafulla Chandra Ray (1861-1944) after education in the British universities. J. C. Bose's case is particularly instructive. For about six years from 1894 to 1900, Bose, working at the Presidency College, Calcutta, studied the properties of short-length radio waves, carrying out numerous experimental innovations in the process. He persistently refused to patent his discoveries, and snubbed British capitalists who tried to convince him. Exasperated by his 'quixotic' approach toward money, two of his lady friends, the British-born Margaret Noble (better known as Sister Nivedita) and the American-born Mrs Sara Bull, on their own initiative, obtained an American patent in Bose's name in 1904. Bose however remained unmoved and refused to encash the patent. The irony of the situation seems to have gone unnoticed. Here, we have a spiritualist (Nivedita) advocating the cause of patents and royalties, and a physics professor dismissing the idea. The reason must be sought in their backgrounds. Nivedita was a product of industrial Europe while Bose was a child of the orientalized East<sup>19</sup>.

Bose's anti-patent position is sought to be explained in his authorized bio-graphy<sup>20</sup>: 'Simply stated, it is the position of the old rishis of India, of whom he is increasingly recognized by his countrymen as a renewed type, and whose best

teaching was ever open to all willing to accept it. Bose carried on his shoulders the full weight of his country's defensiveness. Bose no doubt would have 'made millions' from his patents as P. C. Ray reminded a Calcutta audience in 1916 in Bose's presence<sup>21</sup>, but then Bose would have become a part of Europe's machinery.

As Rabindranath Tagore wrote to him, Bose was God's instrument in the removal of India's shame<sup>22</sup>. In December 1896, Anand Mohan Bose (incidentally, J. C. Bose's brother-in-law) speaking at the 12th meeting of the Indian National Congress in Calcutta declared<sup>23</sup>: 'we know the London Times has only the other day borne testimony to the fact that the year 1896 is an epoch-making year as regards the intellectual advance of India. We know that the grand researches of an Indian Professor in the field of invisible light [J. C. Bose] ... have led to discoveries which have filled the mind of Lord Kelvin ... with wonder and admiration, ... We know of the discoveries which ... have rewarded the genius and the patient toils of another countryman of ours [P. C. Ray] in the realm of Chemical Research. India has shown that she has not forgotten the traditions of her glorious past, ... the Indian mind has awakened to the consciousness of the great destiny before it, and ... has taken the first practical steps towards obtaining its recognition from the generous scholars of the West'. Although the western education had taught the natives about the equality of all human beings, the first tangible proof that the natives could indeed be the equals of the Europeans came from the western recognition won by Bose and Ray for their scientific work.

The early momentum generated by Bose, Ray and the freak mathematical genius Srinivasa Ramanujan (1887- 1920) did carry Indian pure science to its swan-song period of the 1920s and 30s, but no new momentum was ever imparted. The first world war robbed Europe of any claims to moral superiority. As a result, the need to cultivate science as a national symbol disappeared. As the nationalist movement gained momentum, science lost its place on the national agenda. As long as the Indian National Congress was a middle class organization, cultivation of science held a special appeal for its constituents. But when Gandhi with his civilizational posture moved centre stage and made Congress mass-based, the position of science, as exemplified by industrialization, became increasingly untenable.

This change is personified by P.C. Ray, the founder of modern chemical research and manufacture in India. Ray met Gandhi in Calcutta

towards the end of 1901, and was 'attracted to him from the very first by his magnetic personality .and our common devotion to ascetism.' As Ray proudly noted, he was 'in a manner responsible for Mr. Gandhi's first appearance on a Calcutta platform'<sup>24</sup>. When Gandhi first made 'Charkha the symbol of the new movement,' Ray was not impressed. 'Being an industrialist on a humble scale, at first, I scoffed at the very idea of this primitive, uncouth instrument competing with machinery ...' Ray changed his opinion after his active part in the 'relief operation in connection with the Khulna famine and the North Bengal Flood.' I could not fail to notice what an immense boon the Charkha would have proved to the starving people if it had not been abandoned nearly a century before'<sup>25</sup>.

Ray worked out the Charkha economy. If one eighth of India's population of 320 million were to earn 'only 2 pice a day' from spinning, the total would amount to Rs 45,62,50,000 crores per year!' Ray took pains to explain: I need not be understood as saying all big scale industries should be smashed. ... But surely you will agree with me that if the same result can be brought about by means much less harmful, surely that is preferable'<sup>26</sup>. If Gandhi had decreed that the nationalist movement would be financed only from the Charkha earnings, the dispossessed artisan classes would have been economically rehabilitated and socially enhanced. Hopefully after independence they would have been technologically upgraded. The Charkha however never became an economic vehicle. It remained a political symbol, merely a dirge to the dispossessed classes. The Indian leaders solemnly spun Charkha but raised political funds from the industrialists, without realizing the irony.

Science came back into focus with the political emergence of Jawaharlal Nehru (1889-1964). As president of the Congress, he declared in 1936: I believe in the rapid industrialization of the country and only thus I think will the standard of the people rise substantially and poverty be combated'. In 1937, on the occasion of the silver jubilee of the Indian Science Congress he reaffirmed: 'Even more than the present, the future belongs to science and to those who make friends with science and seek its help in the advancement of humanity'<sup>27</sup>.

The Congress did come to limited power in 1937 but resigned two years later. Nehru had to wait till independence in 1947 to implement his agenda of big science.

## **Kshatriya-ization of science**

We can distinguish between three aspects in the development of modern science: intellectual aspect, production of wealth aspect, and the dominational aspect. The (non-white) non-west's view of these developments in the west was blinkered. When science was being developed as a methodology and as an agency that was intellectually uplifting and quality-of-life enhancing, the non-west in general was not a party to the phenomenon. It is a measure of the success of orientalism that modern science was not seen as the latest stage in the continuum of human endeavour to comprehend natural phenomena but as western science set in opposition to the so-called eastern philosophy and way of life. This image of modern science was reinforced by its role as a producer of wealth. To the west, science was wealth; to the east an agency that destroyed traditional manufacture.

However, when the dominational aspects of science were being developed, the (non-white) non-west was fully aware of the process. It was in fact a participant. It contributed to the process by becoming its victim. Domination is a well-recognized old paradigm; modern science was merely an add-on. That is why of all the aspects of modern science, the dominational aspect has appealed the most to the formerly subjugated people of Asia and Africa, who have tended to decouple it from the other two aspects. Thus the most modern weapons, can be used to capture power in Afghanistan, but once the power has been obtained it is not used to bring in other aspects of modern science. Rather it is used to impose a highly outdated mindset.

Although India has been more comfortable with science than other former (non-white) colonies, its collective attitude towards science has been rather ambivalent, a mixture of acceptance and rejection. Thus, Ganesha's imbibing milk could be widely perceived as a proof of the victory of 'our' Ganesh over 'their' science. The irony is lost that the news of this victory over modern science was flashed across the world using the latest gadgets of telecommunication. Independent India, rather indulgently and uncritically, has sought to extend support to science across the board. But, as we have seen, for historical reasons there has been a latent and not-so-latent hostility towards production of wealth through science. The emphasis on the cultural, or Brahminical, aspects of science unsupported by a knowledge-based economy has harmed Indian science. Before the second world war, science was a baby India could

feed. After the war, it soon grew into a giant, outside India's feeding capabilities, Science can be enhanced only by those who harness it. Countries whose GDP does not depend on science cannot 'make friends with science'.

Indian science has been a garden in which weeds outnumber flowering plants but both are nurtured without discrimination. In this regard, an examination of the global publication and citation data in science, engineering and medicine for the period 1981 to 1984 is revealing<sup>28</sup>. (Citation index with all its faults is still a convenient indicator.) The top seven ranks went to the world's seven largest economies, the so-called G7 countries. USA published about 35% of the world's science, with the 15-country European Union taken as an entity coming a close second with about 32% of all papers. India published 2.4% of papers ahead of Australia (2.1 %) and the Netherlands (2.0%). The pecking order, however, gets drastically revised when we try to measure the quality of the average paper. This is done by defining a relative citation index (RCI), that is the number of citations divided by the total number of publications, India's RCI stands at 0.27 as against Australia's 0.97 and the Netherlands' 1.10. (USA heads the list with 1.42.) Far more relevant for India is a comparison with China. Both have the same RCI, but China's share of the publications is much smaller: 0.9% as against India's 2.4%. Obviously then, in absolute numbers, India produces far more trivial papers than China does.

It is significant that India's most notable success on the scientific front has been in what we may call the Kshatriya-ized science, that is in areas related to foreign policy, that is in the nuclear, missile and to a lesser extent, space programmes, which strictly speaking are no more than successful application of known technologies. But then, production of electricity is also a simple exercise in engineering where India's performance has been highly unsatisfactory. (Partial success on the agricultural front also belongs to this category. Increase in food production has not been large enough to feed the whole country, but sufficient to obviate dependence on foreign countries.) These programmes give India a sense of general well-being, because they are seen as strengthening India's efforts towards emergence as a sub-superpower. They tend to mask the failure concerning the intellectual and more importantly the production-of-wealth aspects of science.

Winning freedom through peaceful means has its limitations. It gives continuity even where a discontinuity is needed. The battle of Plassey constitutes a discontinuity. To counter its effects,

another discontinuity was needed which did not take place. The post-Plassey British rule saw the annihilation of the traditional artisan classes. While in Europe, the industrial revolution artisanized the whole society, in India consistent with the composition and aspirations of the new middle class, science itself was Brahminized, that

is, it was viewed as a cultural activity. After independence, consistent with the aspirations of a new nation, science has been successfully Kshatriya-ized. It still remains to be Mandalized, in the sense of creating a new technology-driven artisan class.

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1. Kochhar, R. K., *Curr. Sci.*, 1992 63, 689; Kochhar, R. K., *Curr. Sci.*, 1993, 64,55.
  2. Farrington, B., *Tempus Partus Masculus*, quoted in Keller E. F., *Reflections on Gender and Science*, Yale University Press, New Haven, 1985. I thank Joanna Rankin for bringing this quotation to my notice. See also Bajaj, J. K., *Science, Hegemony and Violence* (ed. Nandy, A.), Oxford, New Delhi, 1990.
  3. Said, E. W., *Orientalism*, Routledge and Kegan Paul, London, 1978.
  4. Kochhar, R., *History of Science in India 1993-96: A Status Report*, INSA, New Delhi, 1997.
  5. Mohmood, S., *A History of Indian Education in India (1781-1893)*, 1899 (Reprinted by Idarah-i Adabiyat-i, Delhi).
  6. Mitra, P. C., *A Biological Sketch of David Hare, 1878* (Reprinted by Jignasa, Calcutta, 1979).
  7. Sircar, M. L., *On the Desirability of a National Institution for the Cultivation 18 of the Sciences by the Natives of India*, Calcutta, 1869 (Reprinted in *Indian J. Hist. Sci.*, 1994, 29; IACS, *A Century: Indian Association for the Cultivation of Science*, Calcutta, 1976).
  8. Thapar, R., *Social Scientist*, 1996, 24, 1-39.
  9. Sen, K. C., *Lectures in India*, Cassel, London, 1901, vol. 1.
  10. The open letter quotes a newspaper of 11 August and was publicly distributed on 19 December, 1894. It must therefore have been composed some time between these two dates, Gandhi, M. K., *Collected Works of Mahatma Gandhi*, Publication Division, New Delhi, 1894, vol. I, pp. 170-189.
  11. The first recorded expression of this awareness is found in Gandhi's after-dinner speech on Christmas day, 1896: 'I therefore deplored the [modern western] civilization of which the Natal whites were the fruit, and which they represented and championed', Parel, A. J., in *Gandhi and South Africa: Principles and Politics* (eds Brown, J. M. and Prozesky, M.), St. Martin's, New York, 1996, pp. 35-67.
  12. Raman, C. V., *Sir Asutosh Mookerjee Silver Jubilee Volumes*, Calcutta University, Calcutta, 1922, vol. II. pp. 179- 185,
  13. Sircar, M. L., 1869, see ref. 7.
  14. Sircar, M. L., 1872-75, S-12, see ref. 7.
  15. IOLR MSS Bur C144/17 at the British Library, London.
  16. Sircar, M. L., 1872-75, S-25, see ref. 7.
  17. The school of industrial arts was set up in 1854, with Mitra serving as its honorary secretary and treasurer. At the turn of the century, under the leadership of Tagore and E. B. Havell, the school was transformed into an institution for fine arts, Ghosh, A., *J. Asiatic Soc.*, 1994,36,74-92.
  18. The other association was the Indian League founded on 25 September 1875, preceding the (political) Indian Association by ten months. The League raised subscription for the polytechnic and refused to merge it with the funds collected for Sircar's Association. It is not clear what happened to the League subscription. (See ref. 14, S-37). There does not seem to have been a firm ideological divide between the proponents and opponents of the polytechnic scheme. The science association does not seem to figure in the Mookerjee Magazine brought out during 1872-76 by Sambhu Chunder Mookerjee (1839-94) who was one of the chief spokesmen for the Indian League. Mookerjee's biography also does not refer to the IACS. It however does reproduce a letter written by Sircar to Mookerjee in 1890, almost a quarter century after the establishment of IACS. In this letter, referring to Mookerjee's 'real affection' for himself. Sircar asked him to use his 'powerful pen' 'to plead on behalf of the only Institution in all India which has inaugurated real, independent, natural scientific education, the permanency of which means the regeneracy of this degenerate country' (Skrine, F. H., *An Indian Journalist: Being the Life, Letters and Correspondence of Dr Sambhu C. Mookerjee*, Thacker, Spink and Co., Calcutta, 1895. Mookerjee was an influential journalist and a homeopath like Sircar. Unlike Sircar who had a regular MD, Mookerjee was a college drop-out and had an MD 'from an American University'.

19. Kochhar, R., Economic Times, 18 March 1998.
20. Geddes, P., The Life and Work of Sir Jagadis C. Bose, Longman, Green and Co., London, 1920.
21. Natesan, G. A. et al., Indian Scientists, Madras, 1929.
22. Tagore, R., Collected Letters, Visvabharati Press, Calcutta, 1957, vol. 6.
23. Quoted in Ray, P. C., Autobiography of a Bengali Chemist, Orient, Calcutta, 1958, p. 126.
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