

BOOK REVIEW

Deepak Kumar, *'Culture' of Science and the Making of Modern India*. New Delhi: Primus Books, 2023. 330 pp.

Deepak Kumar, *Science and Society in Modern India*. Cambridge and New Delhi: Cambridge University Press, 2023. 168 pp.

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The impact of science in colonial territories has become a key theme in the history of imperialism and postcolonial studies. Deepak Kumar's scholarship, along with other works, defined the history of science, technology, and medicine in colonial India. His *Science and the Raj* (1995, 1st edition) continues to be as relevant today as it was when it was first published almost 28 years ago. His hallmark is a judicious mixture of theories with empirical study. His significant conceptual intervention helped distinguish between curiosity-driven science and colonial science, which was a tool for colonial domination and British rule in India.

Although *Science and the Raj* has been widely celebrated and reviewed, little is known about how Kumar developed his original understanding of the subject and brought it to the academic world. The first title under review provides the backstory and conceptual framework for the author's main thesis. The 13 essays in the volume are previously published. However, these writings have been scattered across multiple journals, making exploring them in a cohesive and interconnected manner difficult. They are distributed under five broad parts and the brief introductions to each sub-section help the reader to locate the essays, and understand the themes. The first introductory chapter delineates the concept of HISTEM – the most significant features of which encapsulates histories of science, technology, environment, and medicine, lies in its necessarily interdisciplinary nature. It borrows and benefits from different disciplines. Another important feature, Kumar argues seems to be its utterly secular nature. For example, diseases or epidemics do not differentiate between any caste, creed, or clan. During the Covid 19 epidemic of 2020-2021, the whole world suffered. He asks pertinently, should not we study and teach the history of epidemics, or more specifically history of germs?

The first part has 3 chapters that deal with pre-colonial India. It has always fostered a thinking civilization. The rich scientific tradition in India continuously

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evolves through interaction with the outside world and social change from within. Indian contribution to astronomy, mathematics, and medicine should be examined critically, argues Kumar, in light of new research in the field. The first chapter “Perspectives on Scientific Knowledge in Ancient India” emphasizes that it may not be proper to find similarities between modern knowledge systems and the ancient past. Relevant traces are bound to be there, but these cannot be exaggerated to the extent that all knowledge existed in the Vedas. Even great Indian astrophysicist Meghnad Saha failed to convince the uniqueness of his invention – ionization theory – to an old barrister from his hometown, Dacca. The old man ridiculed young Saha saying these facts were already there in the Vedas!

It was during the seventeenth and eighteenth centuries, the post-Renaissance period (Descartes and Newton) that Europe began to outdistance India in the natural sciences. Several mechanical principles often employed in modern machines were in use in Mughal India, but the range of their application was rather limited. The second chapter “Techno-Scientific Knowledge: A Study of Eighteenth Century India” narrates the story of the scholar-prince of Amber, Sawai Jai Singh (1688-1743), who tried to assimilate and synthesize the astronomical knowledge then available to him. He even brought together a number of astronomers from different parts of the country and almost established “a colony of astronomers.” The major concern of Indian medical tradition was how to prolong life and preserve health and vitality as a whole. Several European physicians visited Mughal India and wrote extensively on Indian medical practices. Although these appeared to them more as a craft, governed by caste rules, some practices like rhinoplasty and the efficacy of Indian drugs amazed them. Yet unlike the West, Kumar argues in the third chapter (Science, Religion, and Society: Gleanings from Our Colonial Past) that pre-colonial India didn’t witness any intense debate on reason, science, and religion. Indians remained obsessed with spiritual and social issues. However, Ahmed Khan defended new knowledge from dogmatist attacks in the name of religion and tradition, and, at the same time, protected the indigenous cultural beliefs from colonial and evangelical aggression. He even objected to the proposal of opening an oriental faculty at Allahabad University (1885), instead preferred teaching in the sciences of Newton, Copernicus, and Kepler.

The next part (An Era of Surveys) explores the contributions of early explorers and surveyors in the consolidation of the empire. In a plantation economy, knowledge of botany was of utmost importance. Later geology emerged as a useful branch of knowledge. In India, as Kumar has shown, scientific surveys, commerce, and the flag went hand in hand without much planning, but their interests did converge. The surveyors were the forerunners of scientific exploration. Here, the first chapter “Survey Explorations and the East India Company” discusses the background of the early surveyors, most of whom came from the military, and from their ranks, early geologists, meteorologists, and astronomers emerged. Another set of early scientists came from a medical background and became the early botanists and zoologists. Despite the fact that they were basically knowledge-seekers, but well

aware of the significance of their work in managing the empire. Interestingly, on several occasions, they influenced metropolitan scientific discourses. People like Rennell, Kyd, Roxburgh, Oldham, and others while facing enormous physical and conceptual difficulties, contributed significantly to both the state and corpus of scientific knowledge. In the initial stages, a colonial scientist enjoyed autonomy to a significant extent. However, as Kumar argues, science gradually came under official surveillance with the consolidation of the colonial arteries.

The second chapter (Scientific Surveys in British India, 1850-1900) is basically a comparative analysis of different survey operations. The botanical survey could not acquire the structural homogeneity and cohesiveness that characterized the Geological Survey of India (GSI). As Kumar argues, despite the awareness of the significance of botanical knowledge, colonizers preferred to keep it flexible so that it could be used diversely. The colonial botanists could never get an imperial cadre – some were attached to the revenue department, some to agriculture, and a few to forestry and medical works. On the contrary, GSI played a decisive role under the stewardship of Thomas Oldham. When he retired in 1874, he left behind him a cadre of efficient geologists. He was even not averse to recruiting ‘natives’ and had pleaded for training in geology at the university level. So, there were contradictions in science administration. This was paralleled to the colonial administration in general – a top-heavy structure.

In a tropical climate like India, agriculture is very significant. To the colonial rulers, however, Indian potentialities meant cash crops and the profits that accumulated. They wanted Indians to grow cotton, jute, opium, tobacco, indigo, and tea. Therefore, the colonies were called plantations. The third chapter, “Science in Agriculture: A Study in Victorian India”, emphasizes that maximum profit from agriculture was the hallmark of British policy. Unlike in Europe, where agricultural education was meant both for the farm-holders and farmers, in India colonial masters wanted to educate the rising generation of the zamindars, not the peasants. An agricultural chemist J. A. Voelcker visited India in 1890 and three years later produced a huge report on the improvement of Indian agriculture. He emphasized the utility of experimental farms, the need for agricultural chemists, and the spread of agricultural education. He wanted the government to assume the responsibility to carry out scientific agriculture. However, the government looked to the middle class for leadership. Obsessed with literature and philosophy, according to Kumar, the *bhadralok* seldom took to scientific agriculture.

The third part (A Colonial Helix) deals with the intersections between science, colonialism, and Indian society. The first chapter “Patterns of Colonial Science in India” seeks to explore the paradigms of scientific development in a colonial milieu. It underlines the nature, scope, and significance of the close link between science and imperialism in nineteenth-century India. Kumar argues that perhaps no word other than ‘Colonial Science’ can describe so appropriately the functioning of sci-

ence under a colonial context. Excessive government control over scientific undertakings often hampered the organic growth of science in India. Kumar identifies another significant feature as the relative neglect of medical and zoological sciences contrarily to a huge investment in botanical and geological surveys from which they could get substantial economic and military advantages.

The next chapter (Racial Discrimination and Science in Nineteenth-Century India) is very significant. The continuous display of new knowledge, tools, and technologies produced ripples in the minds of the 'natives' who in turn wanted to learn the art. Despite the limited opportunities, some of them excelled in subjects like biology, chemistry, and mathematics. As early as 1848, two Indian doctors (B. N. Bose and A. N. Seal) returned from England with a recommendation from the Court of Directors for professorship at the Calcutta Medical College. The Government of Bengal summarily rejected saying this could likely aggravate the ambitions of others. Absolute geniuses like Mohsin Hossain, Radhanath Sikdar, and others never get their due credit. The British government didn't pay any heed to the continuous demand of the vernacular press for better scientific education. Instead of implementing a proper education system in various branches of science, they put heavy emphasis on mathematics alone. The first Indian who offered a graded service was geologist P. N. Bose. But he also faced immense discrimination and took an untimely retirement from service when he was superseded by T. Holland as the director of GSI. He had been junior to Bose in service by about ten years. Another case of discrimination on the racial ground was none other than J. C. Bose. Till the Royal Society accorded Bose recognition, the Presidency College, his workplace, refused him any research facilities and considered his work purely private. Tagore came to his rescue and collected twenty thousand rupees to construct a research laboratory for J. C. Bose. One can give several such examples. Original scientific research was difficult to flourish in the midst of racial discrimination. Indians despite their credentials, as a matter of policy, were excluded from any effective participation in government scientific undertakings.

Next, comes the question of the encounter. How did different nations view each other's scientific credentials? The last chapter (The 'Culture' of Science and the Colonial Culture, India 1820-1920), focuses on facets such as the confidence of one and the diffidence of the other; the disjunctions, the gaps, and the efforts to bridge them; and the inner inconsistencies and contradictions that characterize the relationship. While assessing the initial Indian contribution to modern science, one cannot simply ignore the colonial parameters and structures. This was also the period of massive translation of European sciences into Indian languages – so, we have translation enthusiasts like Balshastrī Jambhedkar and Master Ramchandra. The most crucial characteristic of mid-nineteenth-century Indian thinking was an unprecedented emphasis on cultural synthesis. According to Kumar, the idea gave Indian intellectuals the best of both worlds. Thus, Akshay Kumar Dut worked for 'Indianizing Western science.' Another crusader Mahendra Lal Sircar realized the necessity

of re-articulating science in national terms. He established the Indian Association for Cultivation of Science (1876) combining the character, scope, and objects of the Royal Institution of London and of the British Association for the Advancement of Science. In the last decades of the nineteenth century, some of the individual 'native' scientists gathered sufficient strength to differ from their metropolitan peers and fight colonial bureaucracy. The contribution of J. C. Bose and P. C. Ray in creating an international reputation for Indian science is undeniable. The notions of science and its terminologies entered so deep into the political and cultural lexicon of the country, Kumar argues, that no politician and social reformer could afford to ignore them.

The last part of the book deals with the development debates that took place in the early twentieth century. In the preceding century, the colonial records talked about 'improvement' – moral as well as material. In the twentieth century, the discourse changed to development, a very interesting and ambiguous term that is still in vogue. The first chapter, "Science, Technology, and the Development Discourse, 1900-1947", asks two significant questions: First, how was the colonial government going to use the techno-scientific knowledge for the material development of India? Second, how would Indians articulate demands for national reconstruction and press for it? During that period, not only Indians craved autonomy, but as Kumar identifies, the British scientists working in Indian establishments also wanted more liberty from metropolitan control from London. The creation of the Board of Scientific Advice (1902) was the declaration that science in India could and should be cultivated without supervision from London and that the country's preference for the 'natural history' sciences must be replaced by public-sponsored industrial research. Unfortunately, there was no discussion and much less cooperation between the British officials and the Indian leaders with similar ideas. Many Indian scientists and thinkers sought solutions for the country's problems, but their methods differed. P. C. Ray saw the remedy in *Swadeshi* and *Charkha*. Visvesvaraya asked for rapid industrialization using Indian capital and enterprise. Meghnad Saha insisted on the 'scientific method' in every aspect of national life. S. S. Bhatnagar and Homi Bhabha preferred to build centres of excellence in frontier areas of scientific research. Another significant incident was the constitution of the National Planning Committee (1938) under the chairmanship of Nehru. As many as twenty-nine expert sub-committees were formed to address different areas of national reconstruction, including agriculture, industries, population, health, irrigation, energy, and education.

Not only Indian men of science, but several British scientists believed and worked on similar objectives. A. V. Hill emphasized that health and population problems were to be taken seriously, and agriculture and industry were to be brought together. J. D. Bernal wanted India to make the most scientific use of its resources. The period 1937-47 deserves more attention. Besides NPC publications, the Bombay Plan, and Hill's report, Kumar argues, other significant studies emerged. Health and industrial

research, for example, were explored in committees under the chairmanship of Joseph Bhore and Shanmukham Chetty, respectively. All these committees unanimously asked for greater institutionalization. The discourse was run entirely by ‘experts’ – both Indians and Europeans – and common people had a very limited place. It assigned a far greater authority to the state. The outcome was, as Kumar mentions, centralization and concentration of power which became the hallmark of the scientific establishment in post-independent India.

The last two chapters on Tagore and Gandhi, both of whom were village-centric, both wanted to empower the poor. However, their diagnosis and prescription differed. The chapter, “Tagore’s Pedagogy, Science, and Rural Reconstruction”, deals with his educational ideas and pedagogy, and relates them to the ideas of other contemporary thinkers like Gandhi, Patrick Geddes, and Leonard Elmhirst. Interestingly, Tagore was not a professional educationist. He entered the field of education through his poetry and his experiences in life. He discussed the problems and importance of the teaching of science on several occasions. He argued the Association for the Cultivation of Science (established by Mahendra Lal Sircar) not limit its activities to the education of the upper strata of society. It should take root among the masses as well. The success of cooperative movements in Denmark and Ireland inspired him. This cooperative spirit was reflected in the Sriniketan experiment. With the help of Elmhirst, experiments were done on different types of crops, fertilizers, manuring, deep ploughing, and mechanization. Gandhi was no less unique. He seldom used the terms ‘science’ and ‘technology’. His concern was civilization and mechanization. The last chapter (Mahatma and the Machine: Gandhi on Technology) of the volume emphasizes how several years of thinking and dialogue with his peers made Gandhi launch a severe civilizational critique of the West. He condemned the West precisely for the same reasons for which it had prided itself for so long – science and technology, with all its achievements, consequences, and ramifications. He believed that machinery, the chief symbol of modern civilization, was a great sin. It (along with Manchester) had impoverished India. He was very worried about the growing number of idle hands. Greater use of heavy machinery would render more and more people idle. Charkha was his prescription for the idle moments. Kumar mentions how Gandhi tried to convince people that he was not an opponent of science. Later, he even agreed that some key industries were necessary. He wanted to put certain limitations on scientific research – these limitations were humanity and morality. Thus, according to Kumar, the notion of social accountability remains the most important contribution of the Gandhian ideology.

‘Culture’ of Science and the Making of Modern India ends with a comprehensive bibliography. This can be a ready reference tool for scholars. With this, we have the backstory to *Science and the Raj* and are thus able to understand how a new field evolved through careful and painstaking research.

Approaches to the study of the history of science have undergone critical changes in recent years. While covering the most recent arguments in the field, the second

volume under review, outlines the role and place of modern scientific discourse that occupied a significant place in the colonization of India. Divided into six chapters, this short introduction (around 60000 words) is very useful to conceptualize the science, society, and government interface in a nutshell. Indian society has always nurtured a thinking civilization. In this context, Kumar asks a few pertinent questions: How does one place scientific developments in the civilizational growth of India? What constitutes science in the context of our ancient past? Pre-colonial India was known for its contributions to astronomy, medicine, and mathematics. Scientific and technological activity during medieval times was both continuous and vigorous. However, seventeenth century onwards, Europe began to outdistance other cultural areas including India. For Kumar, the major differences may not be in the state of knowledge, but in the state of organization and activity. The eighteenth century proved unique to India – the rise of modern science coincided with the rise of merchant capitalism and colonial expansion.

Colonial expansion required knowledge of the terrain, its people, its resources, and so on. No domination could be established without this knowledge. It could only be obtained through scientific explorations and surveys. The early surveyors worked under a dual mandate under which both commercial and knowledge components had to be taken care of. The scientific institutions were modern icons. These came to India as part of the colonial baggage, and soon became the carriers of new ideas and in fact symbolized modernity. The Asiatic Society of Bengal (1784) was the sole edifice of scientific research in Asia for more than a century. It gave birth in successive periods to the Geological Society, the Indian Museum, the Botanical Survey, the Meteorological Department, and many more. These institutions were not simple replicas of their metropolitan counterparts. For the smooth functioning of these scientific enterprises, a large cadre of efficient at the same time cheap labour force was required. The complete importation of trained Europeans was not economically viable. Thus, the journey of scientific education began in India, although at a very rudimentary level. Even then there were several obstacles. Apart from the very aim of the educational policy (character formation), the conservative section of Indian society opposed scientific and medical education.

The pattern of engineering education in India differed from Britain. There it evolved from below and gradually became part of the university curriculum, whereas in India it was organized from above. Every aspect of engineering education was controlled by the PWD. It had definitely a detrimental effect on the discipline. The introduction of steam vessels, railways, telegraphs, printing press, and later electricity, attracted considerable Indian attention. However, technology transfer under colonial conditions offered very little scope for the adaptation of these technologies by the Indian people. As Kumar argues, a geographical relocation of technology (railways for example) was possible and was achieved, but a cultural diffusion of tech-

nology was much more complex and different. He identifies a ‘scrupulously selective’ Indian approach towards modern technology, depending on their convenience and utility.

A section of Indian erudite was quick to recognize the changes and new opportunities. Ishwar Chandra Vidyasagar wanted Indian students to study their own ‘false system’ along with Western science in his Sanskrit College, Calcutta. Rajendralal Mitra edited two pictorial scientific journals with high repute. Despite his admiration for Bengali, he firmly believed that science education had to be delivered in the English language only. Religion appears as a major obsession in almost every type of encounter – political, social, or cultural. Syed Ahmed Khan made it very clear- to him the real purpose of a religion is to improve morality and let scientific truths be established by observation and experiment. Swami Vivekananda accepted the superiority of Western science and technology and wanted to reciprocate with higher religious and spiritual insights. Swami Dayanand, on the other hand, claimed India as the original home of modern science and tried to demonstrate that certain elements of it could be found in the Vedas. For Hakim Ajmal Khan of Delhi and Vaidya P. S. Varier of Kottakal, the Western system was not an anathema, and both were keen to borrow and internalize from an alien medical system.

Mahendra Lal Sircar argued against the prevailing contention that the Hindu mind was metaphysical. The foundation of his Indian Association for the Cultivation of Science (1876) was no less important than the establishment of the Indian National Congress, nine years later, argues Kumar. The association symbolized the search for an Indian identity in the world of science. Madan Mohan Malaviya presented a nationalist critique of British economic policies in India. The British model was inadequate. The new icons were Japan and Germany, and the new watchword was science-based technology. Benoy Kumar Sarkar used interesting terms like ‘mistrification’ and ‘factorification’. The importance of artisans and technicians (*mistri* refers to technicians) was thus brought into focus. The demand for chemical industries was ably advocated and pushed by scientists like P. C. Ray. The Indian thinkers of Victorian India were well aware of the contradictions and the dilemmas that they faced. Most of them took a middle stand and worked for both material benefits and traditional values.

In the now-burgeoning literature, terms like tropical medicine, imperial medicine, and colonial medicine have been often used interchangeably. However, Kumar clarifies that they have specific connotations. Tropical medicine and imperial medicine emphasize the tropics and the empire as units of analysis while colonial medicine stresses the colony. The establishment of Calcutta Medical Knowledge (1835) was definitely a milestone, especially in the realm of anatomical knowledge. From the Indian point of view, the mid-nineteenth century was a period of looking for fresh opportunities. Fascinated by the different systems of medicine, Raja Serfoji of Tanjore opened an institution for research in medical science. A self-taught doctor, he is

said to have learned the art of cataract removal. A graduate of Calcutta Medical College, S. C. Chuckerbutty was one of the first four Indian medical graduates sent to England in 1845 for higher studies. He opposed medical education imparted in Sanskrit or Arabic. But his perceptions changed later and came to support the vernacular medium. The encounter between practitioners of indigenous medicine and modern medicine produced hybrids known as *daktars* who served in semi-urban and rural societies. Kumar opines such hybridization had its own dichotomies; it lacked coherence and organic growth. In this context, he asks a pertinent question: How 'public' was public health? Unfortunately, it remained limited to the compilation of rather inaccurate vital statistics, vaccination, segregation, and so on. The suggestion to inoculate pilgrims going to Prayag Kumbh was considered impracticable by the Pilgrim Committee. Had the practitioners of indigenous medical systems been co-opted, argues Kumar, public health might have made more progress.

By the mid-1930s, the long-drawn freedom struggle had begun to yield significant results. India had by then entered a phase of transition from dependence to independence. National leaders began to visualize how independent India would look like and what steps were to be taken. However, the immediate inspiration and models came from the USSR. Two things were crystal clear – (1) reconstruction required planning, and (2) it needed science and technology. The National Planning Committee placed special emphasis on large-scale industrialization, bestowed agriculture the status of an industry, and many more. From the beginning, it had laid bare inherent tensions and contradictions. Gandhians (J. C. Kumarappa and S. N. Agarwal) preferred traditional technology and village industries; whereas younger leaders of the Congress, leaned towards modern science, technology, and heavy industrialization. Indian public opinion was markedly divided on whether to adopt socialist methods or accept the capitalist model. Even the British government didn't sit idle – Kumar interestingly terms this phase as the last flicker of 'constructive imperialism.' A committee to discuss medical issues was formed under Joseph Bore and a very comprehensive report was prepared. The All India Institute of Medical Sciences (AIIMS) owes its origin to this report. Similarly, N. R. Sarkar Committee was constituted to discuss technical education. It recommended the establishment of an Indian Institute of Technology (IIT) on the pattern of the Massachusetts Institute of Technology (MIT).

Nehru, the first Indian prime minister, talked about scientific temper as a way of life. He had a personal rapport with scientists who wanted to build institutions, like S. S. Bhatnagar and Homi Bhabha. The chain of laboratories established under the CSIR between 1947 and 1954 was known as the result of the 'Nehru-Bhatnagar Effect'. A few years later, the Scientific Policy Resolution was adopted by the Indian Parliament (1958). Nehru had skillfully perfected the art of mixed economy and mixed politics. According to Kumar, he tried to combine Gandhi and Vivesvaraya; however, he could finally do justice to neither. Indira Gandhi, the next prime minister, turned the focus towards rural India. Experiments were made for introducing fertilizers, irrigation techniques, hybrid seeds, and for plant and soil development.

Under the leadership of C. Subramaniam, India soon to reap the benefits of the Green Revolution. After the sad demise of Indira Gandhi, the baton passed to the young Rajiv Gandhi. He was the first to talk about the twenty-first century and India's place in it. In 1986, he introduced a National Education Policy which emphasized inclusive education and took literacy to a much higher level. The neoliberal policies of the 1990s and the new century under successive prime ministers facilitated the growth of a middle class fascinated by the new knowledge economy and new knowledge society. In many developing countries like independent India, technology somehow dominates basic sciences. In sharp contrast to the early twentieth century, when scientists like J. C. Bose, C. V. Raman, and others were eulogized for their fundamental contributions, today nuclear or missile engineers are greeted as scientists. Even in politics, regrets Kumar, the respect for science is so low that transferring a minister from the education or health ministry to the ministry of science and technology is considered a demotion!

Keeping in mind the conceptualization of the book as aimed towards early and postgraduate students (and even the lay public), *Science and Society in Modern India* is remarkable in its conception, organization, and comprehensive coverage. It is also well produced as may be expected from Cambridge University Press.