Science and Empire: How Technology was Used in India During the British Rule

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***Abstract*—The history of science and technology is intricately linked to the history of colonial India. Almost two centuries of British colonial control in India included scientific intervention and technological advancement in addition to political dominance and economic exploitation. In addition to becoming instruments of empire, railways, telegraphs, irrigation projects, medical facilities, and survey activities also came to represent modernity. However, colonial agendas of control, government, and extraction molded this modernity, which was neither neutral nor equal. The way science and technology operated in India during British colonialism is critically examined in this essay. It examines the twin use of scientific methods: first, as tools of imperial authority that restructured the environment, economy, and society of India;**
on the other, as locations where Indian actors interacted with, adopted, and occasionally contested colonial science through negotiation, resistance, and hybridization. Based on the writings of historians like David Arnold, Deepak Kumar, Pratik Chakrabarti, and C.A. Bayly, this study makes the case that colonial science was a dynamic process of interaction influenced by empire, economy, and culture rather than just the dissemination of Western knowledge to the colonies. The study shows how the technologies of empire functioned as both tools of dominance and drivers of long-term social and economic development in India by concentrating on railways, telegraphs, public health, agriculture, and educational initiatives.

***Index Terms*—Colonial Science; Technology; British Empire; Railways; Public Health; Knowledge Systems.**

I. INTRODUCTION

India's modern science and technology history is inextricably linked to its colonial experience. The British Empire, which solidified its control during the Battle of Plassey (1757) and governed until 1947, made science and technology important to governance. To comprehend this phenomenon, one must place colonial India within the larger context of "science and empire." In the nineteenth century, science was inextricably intertwined with the politics of empire-building, resource extraction, and social control.

The British frequently portrayed themselves as the bearers of reason, progress, and enlightenment in a land they saw as stagnant, superstitious, and backward. Such narratives were essential for legitimizing colonial authority. The construction of railways, canals, and telegraph lines was not only welcomed as a sign of modernity, but also as evidence of Britain's civilizing mission. However, beneath this rhetoric lied the essential truth that these technologies were primarily used to suit colonial needs: transporting troops quickly, easing revenue collection, exporting raw materials, and integrating India into British-dominated global capitalist networks.

However, colonial science was not imposed in a one-sided manner. Indian civilization interacted with Western scientific methods in sophisticated ways rather than passively absorbing them. Indian professionals, intellectuals, and reformers frequently construed science to fit nationalist goals and indigenous customs. Indians were able to use contemporary science as a vehicle for political resistance and cultural change, as evidenced by the founding of organizations like the Indian Association for the Cultivation of Science (1876) in Calcutta. As a result, science was constantly disputed in colonial India since it could be used as a tool for both emancipation and control.This phenomena has been referred to as the "colonization of the body" by historians like David Arnold, who emphasize how sanitary and medical practices were frequently designed to protect European lives rather than to promote the health of indigenous people. In a similar vein, Deepak Kumar has maintained that colonial

science was a selective endeavor, promoting some disciplines—such as agricultural experiments and tropical medicine—while disregarding others that did not directly advance imperial objectives. Pratik Chakrabarti also highlights how colonial India served as a "laboratory of empire," conducting medical, botanical, and resource management experiments for both the Indian setting and the larger tropical world.

This article will examine the role of science and technology in colonial India using three interconnected perspectives. First, it will look at how science was used as an instrument of empire, creating knowledge that legitimized colonial control and aided exploitation. Second, it will look at technological undertakings like railways, telegraphs, irrigation systems, and medical institutions that became symbols of the colonial encounter. Finally, it will study how Indians themselves engaged in these transformations, building hybrid knowledge systems and laying the groundwork for modern scientific institutions in postcolonial India.

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The paper will argue that science and technology during colonialism cannot be viewed as neutral sources of modernization. Rather, they were profoundly ingrained in imperial power systems while also capable of producing unforeseen outcomes that aided social transformation and nationalist movements.

Colonial Science: Knowledge and Power

Colonial science was not a neutral quest for knowledge; rather, it was a weapon of power employed by European empires to govern and exploit colonial territories. Botany and geology were scientific fields used to find and harvest natural resources, while medicine was employed to regulate colonial forces' health. This method frequently ignored and exploited indigenous knowledge of colonial peoples, maintaining a racial hierarchy in which European knowledge was positioned as superior. Finally, colonial science left a legacy in which knowledge was used not just to understand the world, but also to exert dominance over it, with long-term consequences for postcolonial communities and the practice of science itself.In colonial India, science was never an impartial discipline; rather, it was a field shaped by the asymmetry of empire. Science in the colonies was a conscious effort to gather, categorize, and regulate information, as colonial knowledge historians have demonstrated. It was not just a transplant of European reason. A complete system of knowledge about India's geology, flora and wildlife, resources, people, and illnesses was sought after by British scientists and administrators in order to make the subcontinent readable and manageable. Colonial science and colonial power were thus inextricably linked.

II. SURVEYS, MAPPING, AND THE PRODUCTION OF KNOWLEDGE

Surveys and mapping are fundamental processes in the production of knowledge, serving as crucial tools for understanding, managing, and controlling space. Historically, they have been instrumental for civil, military, and administrative purposes. By systematically measuring and recording geographical features, land boundaries, and resources, surveys provide the raw data that cartography uses to create maps. These maps transform complex spatial information into a visual, organized, and comprehensible format.

In a colonial setting, this process was highly political. Colonial powers employed surveys and mapping to not only document but also rule. The British, for example, performed large surveys in India to estimate income, identify natural resources, and construct infrastructure such as railways. This "scientific" paperwork provided them with an authoritative and supposedly objective method for controlling territory, classifying populations, and legitimizing their power, often at the expense of local, indigenous knowledge. Thus, surveying and mapping were used not only to generate knowledge, but also to assert dominance.

One of the first and most important t initiatives was the survey of Indian territory. Beginning with the Great Trigonometrical Survey (1802), the British embarked on systematic mapping efforts that ended in one of the most ambitious geographical endeavors of the modern era. These surveys were more than just scientific exercises in measurement; they were actions of expropriation. By mapping mountains, rivers, and borders, the British converted India into a recognizable and governable territory. According to Bernard Cohn and C.A. Bayly, information was

power: cartography enabled the colonial authority to establish revenue settlements, plan military campaigns, and validate territorial claims.

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Similarly, ethnographic investigations, such as H.H. Risley's The People of India (1908), aimed to divide Indian culture into rigid racial and caste hierarchies. These categories, which were frequently based on pseudoscientific beliefs about race and anthropology, reinforced colonial notions of difference. By depicting Indians as fragmented, illogical, and divided, the British justified their position as neutral arbiters and rulers. Thus, science was used to normalize social inequalities and undermine any threats to colonial rule.

Surveys and mapping are not only technical operations; they are deeply political acts of knowledge generation. They have historically played an important role in expressing and preserving power, notably during colonialism. Surveys provided colonial powers with an authoritative and objective-seeming technique of controlling territory, imposing new administrative structures, and exploiting resources by quantifying and visualising land, resources, and inhabitants.Maps developed from this material became strong weapons of dominance, legitimizing imperial claims while marginalizing indigenous peoples' detailed, place-based knowledge. The act of mapping a territory changed it from a living, complex landscape to a static object under control. Thus, surveys and mapping demonstrate how knowledge can be a direct instrument of power, molding and reshaping the world to meet a specific agenda.

III. MEDICINE, SANITATION, AND THE COLONIZATION OF THE BODY

Sanitation and medicine were effective means of colonizing the body in colonial settings. They were intricately linked to imperial objectives of dominance and control and went beyond merely enhancing public health. In order to ensure the economic and military sustainability of the colonies, medical and sanitary measures were mainly put in place to safeguard the health of colonial administrators and military troops.

Racial segregation was frequently justified by sanitation initiatives, such as installing new drainage systems and enforcing quarantine regulations, which physically divided "clean" European residential districts from "unhygienic" native sections. One of the main tools used to establish European supremacy and justify the colonial enterprise was this medicalized control over the bodies and health of the colonized people.

Another important area of colonial knowledge was medical science. India's tropical climate, which Europeans frequently believed to be a haven for diseases, made the creation of specific medical procedures necessary. Protecting the health of Europeans soldiers, authorities, and settlers—was the main goal of colonial medicine, not enhancing the health of the Indian populace.According to David Arnold's Colonizing the Body (1993), the body has become a place of colonial authority. Vaccination campaigns against smallpox, hygienic reforms in cities, and hospital systems were implemented selectively, often eliciting opposition from Indian populations who saw them as intrusive. For example, during the plague pandemic in Bombay in 1896, coercive measures such as compulsory hospitalizations and house searches sparked massive dissatisfaction. While colonial medicine established modern hospitals and research organizations such as the Pasteur Institute, their execution was influenced by compulsion, surveillance, and racial hierarchy.

New types of hybrid medical practices were also created as a result of colonial contacts. Over time, indigenous systems like Ayurveda and Unani medicine mixed with Western medicine. Despite being frequently written off as "unscientific" by colonial authorities, these systems continued, changed, and occasionally included contemporary pharmaceutical techniques. In defiance of Western biomedicine's epistemic domination, Indian nationalists started to recover traditional medicine by the late nineteenth century as a sign of cultural pride.

IV. AGRICULTURAL SCIENCE AND RESOURCE EXTRACTION

In colonial empires, agricultural science served as a means of economic exploitation and resource extraction rather than for the benefit of the indigenous population. Monocultures, or the

production of a single crop, were brought by European powers and produced high-value commodities including cotton, tea, coffee, and rubber.

Landscapes were altered by this method, frequently by displacing native food crops and removing a variety of forests. These plantations often caused famine and extensive ecological harm because they put export production ahead of local food security. Also suppressed by colonial agricultural science were indigenous farming practices, which were frequently more environmentally friendly and sustainable. By essentially repurposing colonial lands as productive raw material suppliers, it strengthened an oppressive global economic structure.

Agricultural science was one of the primary drivers of economic exploitation and resource extraction in colonial empires. European powers applied scientific methods to agriculture, not for the benefit of locals, but to increase profits for the metropole. Monocultures of high-value cash crops, such cotton, tea, and coffee, were established because of their high demand for industrial production. Numerous food crops were uprooted, vast plantations run by colonial businesses were developed, and large swaths of woodland were regularly devastated for this scientific process. It relied on suppressing indigenous agricultural knowledge and practices, which were often more ecologically friendly and better adapted to local conditions, and continuously prioritized export-oriented production over local food security, leading to terrible famines and ecological destruction.

The economy of extraction was closely related to colonial science as well. For instance, agricultural experiments were carried out at research stations in Coimbatore and Pusa (Bihar) with the goal of boosting the production of cash crops like cotton, opium, and indigo—commodities essential to British industry and international trade. Another colonial endeavor was scientific forestry, which aimed to control trees to guarantee a consistent supply of lumber for railroads and naval construction rather than for ecological preservation.Local knowledge was frequently ignored and traditional agrarian systems were upset by such initiatives. As was evident in the late nineteenth century, the focus on cash crops exacerbated famines and food insecurity. However, these initiatives also established the foundation for contemporary agricultural research establishments in India, which the postcolonial state later commandeered for its own developmental objectives.

V. SCIENCE AS IDEOLOGY AND LEGITIMATION

An ideology that viewed Britain as the leader of modernity and reason drove all of these scientific endeavors. Colonial science painted a notion of a "scientific empire" where the ideas of development and objectivity served as the foundation for the rationale for governance. The measuring, classification, and experimentation procedures itself reinforced the notion that India was a backward country that required Western knowledge to advance. Deepak Kumar argues in Science and the Raj (1995) that colonial science was inherently "selective." Botany, tropical medicine, geology, and meteorology—disciplines that supported imperial administration, military power, and commerce—were actively promoted. Others that could promote independent industry or empower local artisans received no assistance.

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One example of how power dynamics and knowledge production were intertwined is the field of colonial science in India. In addition to being scientific accomplishments, surveys, maps, medical campaigns, and agricultural trials served as control mechanisms. The British also created the power to rule India by creating information about it. To ensure that colonial science remained a place of negotiation rather than outright dominance, indigenous actors frequently opposed, modified, and reinterpreted scientific processes.

VI. TECHNOLOGY AS AN INSTRUMENT OF EMPIRE

Technology was an important imperial tool, employed by European nations to facilitate military conquest, economic exploitation, and colonial administration over vast territory. The steamship, telegraph, and railways revolutionized

communication and transportation, allowing metropoles to impose authority over distant colonies.

Military innovations, such as breech-loading rifles and machine guns, provided invaders with a significant advantage over indigenous opposition, making it simpler to establish and sustain authority. In economic terms, technology such as automated mining and large-scale irrigation systems were used to maximize resource extraction and agricultural production. These tools were not neutral; they were intended to assist colonial goals, frequently damaging local enterprises and undermining indigenous technological traditions.

While colonial technology provided the tangible tools for consolidating and maintaining British control, colonial science developed the body of knowledge needed to administer India. The technological initiatives of the empire began to significantly alter India's geography, economics, and society around the middle of the 1800s. The most obvious representations of modernity were railroads, telegraphs, canals, and medical facilities, which the British hailed as gifts of advancement. Beneath this rhetoric, however, was an obvious reality: these technologies were not created to advance the wellbeing of indigenous people, but rather primarily to protect imperial interests.

VII. RAILWAYS: THE STEEL SINEWS OF EMPIRE

Perhaps the most iconic technological intervention of the colonial state was the construction of the Indian railway network. Initiated in the 1850, the system expanded rapidly under a policy of “guaranteed returns,” whereby private British companies invested in railways backed by government subsidies. In late eighteens India had one of the largest railway networks in the world.

The railways fundamentally altered India’s physical and economic geography. For the colonial state, they were first and foremost a strategic military tool. Troops could be transported swiftly to suppress rebellions or defend frontiers, as demonstrated during the 1857 Revolt, when railways proved indispensable for the rapid movement of forces. Secondly, railways served the economic agenda of the Raj: they facilitated the export of raw materials like cotton, jute, coal, and wheat to Britain, while enabling the import of British manufactured goods into Indian markets. This integration entrenched India’s role as a supplier of raw materials within a global capitalist economy centered in Britain.

While railways did contribute to the spread of markets, urbanization, and mobility for Indians, the benefits were uneven. Freight rates were structured to favor exports, while passenger services for Indians remained overcrowded and underfunded. Moreover, as historians like Ian Kerr emphasize, railway expansion was deeply dependent on imported capital, engineers, and machinery from Britain, leaving India technologically dependent and stunting indigenous industrial growth.

Yet the railways also produced unintended consequences. They facilitated communication among distant regions, fostered social mobility, and, crucially, became a platform for nationalist politics. Leaders like Mahatma Gandhi famously used the railways to mobilize masses during the independence movement. Thus, a system designed to strengthen colonial rule inadvertently became a vehicle for its eventual undoing.

VIII. TELEGRAPHS AND COMMUNICATION CONTROL

Alongside the railways, the electric telegraph revolutionized communication in colonial India. Introduced in the 1850s under the guidance of William O’Shaughnessy, the telegraph enabled near-instant communication across vast distances. For the colonial state, its military significance was paramount: during the 1857 Revolt, the telegraph allowed British commanders to coordinate operations, contributing to the suppression of the uprising.

Telegraph lines were often constructed alongside railway tracks, symbolizing the twin infrastructures of control. They connected India to the global imperial network through submarine cables, ensuring that the colonial administration in Calcutta and London remained in constant communication. As Daniel Headrick has argued, the telegraph epitomized “tools of empire”—technologies that enhanced the efficiency of colonial administration and tightened the grip of metropolitan power over distant colonies.

However, much like the railways, the telegraph also had subversive potentials. By the late nineteenth century, Indian newspapers, political organizations, and nationalist leaders began using telegraphic communication to disseminate information and coordinate activities. A technology designed for imperial surveillance thus became a weapon in the arsenal of anti-colonial politics.

IX. IRRIGATION AND CANAL SYSTEMS

Water control and irrigation projects were another central pillar of colonial technological interventions. The British invested heavily in large-scale canal systems, particularly in Punjab and the United Provinces, with the twin aims of increasing agricultural productivity and securing land revenue. The construction of canals such as the Ganges Canal (completed in 1854) was hailed as an engineering marvel of its time.

Colonial irrigation policy, however, was shaped less by altruistic concern for peasant welfare and more by fiscal imperatives. The state sought to maximize revenue by stabilizing agricultural output, particularly in cash crops. While canal irrigation did expand cultivated land and create new agrarian frontiers in Punjab, it also entrenched inequalities. Wealthy landowners benefited disproportionately, while small peasants often faced increased rents and indebtedness.

Moreover, irrigation schemes often ignored local ecological conditions. Excessive canal irrigation led to problems of waterlogging and soil salinity, damaging productivity in the long run. Mike Davis in Late Victorian Holocausts (2001) argues that colonial irrigation, rather than preventing famines, often exacerbated their impact by prioritizing revenue collection over relief measures. Thus, while irrigation projects transformed India’s agrarian landscape, they reflected the extractive logic of empire rather than developmental planning.

X. MEDICINE AND PUBLIC HEALTH INSTITUTIONS

Technological interventions in the realm of medicine also played a significant role in the colonial project. Institutions such as the Calcutta Medical College (est. 1835) marked the introduction of Western medical education in India. Hospitals, dispensaries, and laboratories were established in major cities, creating a new infrastructure of biomedical science.

Yet, as David Arnold reminds us, colonial medicine was racially stratified. European soldiers and officials received priority in treatment, while Indian patients were often relegated to underfunded facilities. Public health campaigns such as vaccination drives, plague control, and cholera research were often coercive, provoking resistance among local populations. For example, during plague outbreaks in Bombay in the 1890s, intrusive sanitary measures triggered riots, illustrating the fraught relationship between colonial medicine and indigenous society.

On the other hand, these interventions also facilitated the emergence of an Indian medical intelligentsia. Graduates of medical colleges became important intermediaries between colonial science and Indian society. Some went on to challenge Western dominance by reviving and modernizing indigenous systems like Ayurveda and Unani. By the early twentieth century, medicine had thus become a contested field where imperial authority intersected with Indian assertion.

XI. SURVEYING AND SCIENTIFIC EXPLORATION

Along with telegraphs, railroads, and medical advancements, colonial India developed into a gigantic scientific research laboratory. India's mineral richness was documented by geological surveys, which made it possible for British industry to exploit iron ore and expand coal mining. Plants that were beneficial to the empire, such tea, cinchona, and rubber, were acclimated in botanical gardens like those in Calcutta and Saharanpur. In order to protect agricultural profits, monsoon forecasts were made using meteorological surveys.

These exercises demonstrate how colonial science and technology were combined for imperial purposes. Knowledge was generated by surveys, and it was operationalized into control and extraction systems by technology such as irrigation and railroads. The technological interventions of the British Raj were neither neutral gifts of progress nor simple instruments of oppression. They were deeply ambivalent. Railways, telegraphs, canals, and

hospitals were designed to serve imperial interests, yet they also transformed Indian society in ways that the colonial state could not entirely control. While these technologies reinforced exploitation and dependency, they simultaneously fostered networks, mobilities, and institutions that contributed to India's modernization and nationalist awakening.In this sense, colonial technology exemplifies the paradox of empire: tools of domination that, in their unintended consequences, became catalysts for resistance and change.

While colonial science and technology were designed to serve the interests of empire, they did not exist in a vacuum. Indians whether intellectuals, professionals, or ordinary people engaged with these new systems in complex ways. The interaction was not one-sided; rather, it involved processes of negotiation, adaptation, and resistance. This section examines how Indian society responded to colonial knowledge, creating hybrid forms of science and using technological institutions as platforms for both reform and resistance.

XII. INDIAN INTELLECTUAL ENGAGEMENT WITH SCIENCE

By the middle of the nineteenth century, professional schools and colleges founded during colonial control were producing a new class of Indians with Western educations. Graduates from Calcutta, Bombay, and Madras' medical institutions, engineering schools, and universities were knowledgeable about contemporary scientific fields. Many of these thinkers critically assessed the role of science in Indian society, far from being passive consumers.The founding of the Indian Association for the Cultivation of Science (IACS) in Calcutta by Mahendra Lal Sircar in 1876 is one notable example. The IACS was an attempt by Indian intellectuals to appropriate science on their own terms and was the first organization in India dedicated exclusively to scientific study. Sircar maintained that science was crucial for social and moral change in addition to material advancement. His goal was to establish a place for scientific practice that was indigenous and not entirely reliant on colonial support.

Similarly, reformers such as Ishwar Chandra Vidyasagar and later nationalist leaders like Jawaharlal Nehru embraced science as a pathway to modernity and national regeneration. Science was thus reframed within Indian discourse not merely as a colonial imposition but as a universal resource that could empower Indians to break free from dependency.

XIII. RESISTANCE AND CONTESTATION

However, colonial scientific methods frequently sparked opposition. In addition to their coercive tactics, medical measures like immunization and plague control were regarded with distrust since they conflicted with indigenous cultural customs. Violent responses during Bombay's plague outbreak in the 1890s shown how invasive sanitary measures may spark large-scale demonstrations.

Western biomedicine was challenged by indigenous knowledge systems, especially Ayurveda and Unani medicine. In order to demonstrate their ongoing relevance, practitioners of these traditions aggressively defended their epistemologies by starting schools, publishing publications, and updating curricula. The resurgence of indigenous medicine became a symbol of anti-colonial pride as this resistance transformed into a type of cultural nationalism during the late nineteenth and early twentieth century.

Agricultural communities also occasionally opposed scientific advancements. British attempts to implement irrigation plans or new crops frequently ran counter to local ecological knowledge. Farmers in areas like Bengal and the Deccan showed the limitations of technological determinism by adapting, changing, or even rejecting colonial prescriptions.

XIV. HYBRID KNOWLEDGE AND APPROPRIATION

Although resistance was important, hybrid forms of knowledge were also developed by interaction with colonial science. Western-trained Indian physicians frequently combined biomedical and traditional practices, customizing therapies to suit regional conditions. In the fields of construction, agriculture, and crafts, engineers and artists blended old methods with contemporary technologies.

The advent of an Indian scientific elite added to this hybridity. Figures such as Jagadish Chandra Bose

and Prafulla Chandra Ray, both products of colonial educational systems, made fundamental contributions to physics, biology, and chemistry while demonstrating India's capacity for independent scientific achievement. Bose, for example, confronted Western scientific bigotry by demonstrating that Indians could undertake world-class research. Meanwhile, Ray tied his chemistry research to nationalist principles, supporting local industries and advocating for self-sufficiency. These attempts reflected an increasing belief among Indian intellectuals that science could be reclaimed as an instrument for national empowerment. By taking contemporary science and incorporating it into indigenous customs and nationalist aims, Indians transformed colonial knowledge into a tool for self-assertion.

XV. SCIENCE AND THE NATIONALIST MOVEMENT

Science and technology had become central to Indian nationalism rhetoric by the early twentieth century. Nehru and other leaders saw science as essential to creating an independent, modern India. The notion that escaping the bonds of colonial economic exploitation required scientific advancement was propagated by nationalist newspapers and organizations.

This relationship between nationalism and science was brought to light by the Swadeshi movement (1905–1911). The goal to lessen reliance on British goods was mirrored in calls for domestic manufacturing and technical education. Part of this broader goal of scientific self-sufficiency were establishments such as the Bengal Technical Institute, which was established in 1906. In this way, science served as both a battleground where the fight for autonomy was fought and an imperial tool.

The Indian response to colonial science and technology was multifaceted. Resistance to coercive interventions, the revival of indigenous knowledge, the creation of hybrid practices, and the nationalist appropriation of science all illustrate that colonial knowledge was never uncontested. Instead, it was reshaped by Indian actors who infused it with new meanings and purposes. Far from being a monologue of empire, the history of science in colonial India was a dialogue, characterized by tension, adaptation, and transformation.

XVI. CONCLUSION

In imperial India, the history of science and technology is a tale of profound ambivalence. On the one hand, the British used technology and science as essential instruments of their empire. Medical facilities, irrigation systems, railroads, telegraphs, and surveys were all established as strategic tools for government, resource extraction, and control rather than as selfless gifts. Imperial economics and military might influenced them, integrating India into international networks that served the interests of the metropolis. Colonial science was therefore selective, marginalizing indigenous customs and putting local needs last while bolstering British domination.

Conversely, the same interventions had outcomes that went beyond what their designers had hoped for. Technologies like the telegraph and railroads, which were created to bolster imperial authority, ended up serving as platforms for political mobilization, cultural exchange, and social mobility. Although established under colonial authority, scientific institutions facilitated the emergence of an Indian intelligentsia that contested Western assertions of scientific superiority. In reaction to colonial constraints, indigenous knowledge systems resurrected and adapted, demonstrating their cultural endurance and sense of patriotism.

This contradiction highlights how science and technology played two roles in colonial India: they were both tools of dominance and forces for change. In addition to facilitating colonial exploitation, they reorganized India's social and economic structure, laying the groundwork for modernity, industrialization, and the rise of the nationalist movement. By the twentieth century, ideas of an independent India had reframed science as a tool for emancipation.

Thus, the story of science and empire in India is not one of unilateral imposition but of contested negotiations. It highlights the entanglement of knowledge with power, the agency of colonized peoples in appropriating and reshaping technologies, and the unintended outcomes of imperial projects. To study colonial science is therefore to recognize its

complexity: a field marked by exploitation, resistance, and creativity, whose legacies continue to shape India's scientific and technological trajectory in the postcolonial era.

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