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## "Fire-Carriages" of the Raj: The Indian Railway and its Rapid Development in British India



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Towards the end of the nineteenth century, the expansion of railroad lines in British India had effectively reduced the subcontinent to a twentieth of its former size. Places that had been 400 miles apart by non-rail forms of transport were now (in terms of journey-time) only 20 miles away thanks to the speed of the locomotive. Moreover, in terms of material and design, railway infrastructure in colonial India was far superior and more expensive than that found in non-European countries such as the United States. From 1860 onward, British India possessed one of the seven most extensive railroad networks in the world.

Historians agree that technological diffusion from Western Europe to the Indian subcontinent had occurred by the early 1800s. Many, however, have claimed that British colonial rule imposed restrictions on technological development in South Asia. In the case of the Indian railway network, historians such as Ian Inkster and Ian Derbyshire have asserted that the rigidity of colonial policy caused railroad construction to debilitate rather than motivate industrial development in British India during the late-nineteenth century.[1] These authors, however, have overlooked the apparent paradox between, on the one hand, their claims about curtailed technological growth and, on the other hand, the vast as well as rapid expansion of advanced railroad technology.

How then, should we understand the history of railway development in British India from the middle of the nineteenth century to the years prior to the First World War? This paper will investigate why and how British colonial administrations facilitated the large-scale construction of railroad tracks on the subcontinent. In doing so, this study will explain how the British leadership, through creating the Indian railway network, simultaneously arrested some types of technological growth while facilitating the development of the advanced technologies associated with railway construction and operation.

### *The Historiographic Approach*

This paper bases its historiographic approach on scholarship that focuses on the link between the transfer of technology from Britain to colonial India and their metropolitan-periphery relationship. During the 1970s and 1980s, a number of historians assessed the role that science and technology played in European colonial expansion. Among this set of

historians was Daniel Headrick, who evaluated the technological dimension of the relationship between European powers and their colonies. Headrick's approach consists of three central themes. First, the transfer of technology from the metropolis to the periphery was detrimental to the latter. In Headrick's view, technological development in the periphery did not lead to an inevitable process of industrialization but rather to the transformation of traditional economies into underdeveloped ones. Secondly, the metropolis intentionally transferred to the periphery technologies that could be utilized as "tools of empire." The technologies not only accelerated territorial conquests, but also enabled Europeans to control their acquired colonies efficiently and profitably. Lastly, the transfer of technology stimulated cultural and economic changes in the periphery. Through their exposure to the advanced technologies of their colonizers, colonized peoples recognized their benefits and became consumers of the technologies.[2]

Although this paper adopts Headrick's approach, it will also take into account themes from historiographic interpretations that attempt to understand how Western technology has affected colonial India.[3] Ranajit Guha, an influential member of the Subaltern school of historical thought, has convincingly argued that an adequate understanding of the history of colonial India cannot be gained without an awareness of the history of everyday people, a topic largely overlooked in earlier historical works. In following this line of reasoning, like-minded historians have attempted to understand how the transfer of technologies from Britain to British India influenced the Indian populace.[4] Despite being a story that generally involves British actors, this paper will draw some attention to the impact of railway technology on the Indian population.

Headrick did not account for the role that technology played in the state formation of colonial India. As Gyan Prakash has recently pointed out, technology in the subcontinent forged a direct link between space and the state. The development of subcontinental networks of railroad tracks, telegraph wires, irrigation infrastructure, and coal mines in South Asia are a part of a historical process that resulted in the creation of the modern Indian state. These public works were crucial to making the daily administration of such a vast political entity possible and manageable.[5] Thus, in adopting ideas explored by both Prakash and Headrick, the paper will take into account the importance of railroads for

state formation in South Asia *and* how railway development within colonial India fits into the wider historical context of the British Empire.

Before proceeding further, a description of the materials involved in the transfer of railway technology from Britain to colonial India is required. Besides the massive installation of thousands of kilometers of rails, railway construction also required the preparation of rail-beds, the laying of plates, the building of tunnels, the undertaking of heavy-cutting, and the building of bridges wherever necessary. In the early decades of railroad development, British India imported from Britain necessary manufactured products such as rails, sleepers, prefabricated bridges, and locomotive engines. Although Indian workshops began to emerge at the end of the nineteenth century, British manufacturers remained the primary suppliers of these industrial goods. Between 1850 and 1940, more than 14,000 British locomotives were sold to colonial India compared to slightly more than 700 that were manufactured indigenously. Indian workshops such as those established in Lahore focused on repair and assembly work for the duration of this period.[6]

In mainly relying upon manufactured products as well as technical expertise imported from Britain, the colonial establishment oversaw the creation of a state-of-the-art rail transportation network on the subcontinent during the nineteenth century. British rails were carefully and uniformly made, with a precise sectional profile designed to fit exactly on cast-iron chairs, which were in turn bolted. In contrast, American rails, at the time, were not uniformly made and were secured by spikes hammered into the ties. While Americans preferred to use low-cost, mass-produced rails and to build railroad trestles out of timber, British civil engineers in British India always insisted on the installation of more costly but more durable rails and bridges made from brick and iron. Furthermore, whereas British authorities rigorously inspected railway development in South Asia, supervision in the US was, in comparison, considerably lax. Thus, as Daniel Headrick states, the end result in colonial India was a network of railroad lines that were constructed in the British tradition of engineering, which is to say of the finest quality and therefore expensive.[7]

### *The Railway and its Military Application*

Railway promoters active in Britain were well aware of the military utility that a railroad network could provide in colonial India. In 1844 Rowland M. Stephenson, one of the earliest promoters, began to endorse the construction of the so-called "Mirzapore" railway route that would link Calcutta to Delhi, Bombay, and Madras. He claimed that the "first consideration" for such a railway scheme would be the "better security... of the entire country." His proposed railroads would strategically pass through all areas of military importance. Throughout the 1840s, other promoters also voiced military justifications for the development of a railroad network in British India. For instance, William P. Andrews described how a railway system would have prevented the supply and ammunition shortages that occurred during the British-Sikh conflicts and how railroads would serve to rapidly "concentrat[e] troops on a sudden emergency." He also noted that along with reducing the "expenses, delay, and annoyance" of troop movement, railway transportation would "spare the health and save the lives of European troops" who would otherwise be compelled to march through perilous weather and terrain.[8]

While railway promoters and their allies campaigned in London, the Indian government began to view the construction of a railroad network as central to maintaining a military policy of expansion, annexation, and defense. Warfare against the Sikhs during the mid 1840s had revealed the inadequacies of military transportation on the subcontinent. British authorities were aware that military supplies and manpower could have been mobilized far more efficiently if a railroad connecting Calcutta to the North-West Provinces had existed. Unsurprisingly, Henry Hardinge, the Governor-General during the Anglo-Sikh conflict, was in favor of railway development. Within a letter written in 1845 to the Court of Directors, the ruling body of the East India Company (EIC), he stated:

[In a] country where no man can tell one week what next may produce, the facility of a rapid concentration of infantry, artillery, and stores may be the chief prevention of an insurrection, the speedy termination of a war, or the safety of the empire.[9]

Confronted by strong demand for an Indian railway at home and abroad, the Court of Directors eventually acquiesced. In 1849 they authorized two limited liability companies, under the supervision of the EIC, the right to build railroads in British India. However, before large-scale work

could commence, various technical decisions needed to be made. During this period, many proposals regarding how best to establish a railway network in British India were sent to the Court of Directors by various individuals. The most elaborate and influential amongst them was a memorandum written in 1852 by Major John P. Kennedy, a consulting engineer for the Indian government. Kennedy envisioned a railroad network that intricately connected all of the major urban centers in colonial India together, and believed that a so-called "Great North-Western line" should be immediately constructed. The Great North-Western line would connect Calcutta to vast northern borderlands that Kennedy believed were the current hotspots where "conflicts could grow into serious wars." This proposed line would revolutionize the way the colonial regime dealt with defensive and offensive military conflicts. According to Kennedy, this line would enable the "concentration of troops on any required point" in a way that would dramatically increase the military power of the government. Whereas it took three to four months in the previous system to assemble a field force of 60,000 men with sufficient artillery and provisions at a site of combat, the Great North-Western line would hypothetically reduce the mobilization time to a matter of days.[10]

Following the British conquest of the Punjab, James Andrew Broun Ramsay, the Marquess of Dalhousie and Governor-General of India at the time, sought to initiate large-scale railway development. He viewed the railroad as an effective means to bind together old territories as well as newly-conquered ones and in doing so, to secure British military power in colonial India. Although the Great Indian Peninsular Railway route from Bombay to Thana (a 32-kilometer line) had been completed in 1853, Dalhousie envisioned overseeing the establishment of railway projects spanning the entire subcontinent. After reviewing a copy of Kennedy's memorandum, the Governor-General completed a minute to the Court of Directors on April 20, 1853, that outlined his recommendations regarding how railway development should proceed. Deeming Kennedy's railway scheme to be "premature and impractical," Dalhousie preferred instead to direct initial attention to the construction of a railroad network identical to the one proposed by Stephenson in 1844. According to Dalhousie, this railway scheme would prove advantageous in enhancing internal security. It would enable the government to bring immediately the "bulk of its military strength to

bear upon any given point" to an extent that was "physically impossible" at the time. Furthermore, he supported Kennedy's proposal that the Company prioritize the construction of a railway line from Calcutta to the North-Western territories. Aside from forging a connection between Calcutta and the recently annexed Punjab, the railroad line would strategically ensure the long-term protection of British India from external aggression. As Dalhousie explained:

[T]he railway I referred to would be of incalculable value... Touching every military station from Calcutta to the Sutlej, connecting every depot, Allahabad, Agra, Delhi, Ferozepore, with the arsenal of Fort William; it would enable the Government of India to assemble upon [both] frontier[s]... an amount of men and materials of war amply sufficient to deal with any such emergency within a period which would be measured by days; whereas months must elapses, with our present means.

Impressed by Dalhousie's minute, the Court of Directors accepted and implemented his recommendations. In consequence, Dalhousie's minute laid the basis of railway policy in colonial India for the next seventy years.[11]

Although major decisions regarding railway development in British India had been made by 1857, the railroad lines did not play a significant role in the Indian Mutiny (May 1857-July 1858). When Dalhousie departed from colonial India in 1856, thousands of miles were still either under construction or survey. Technical decisions as well as bureaucratic friction between the EIC's resident engineers and government consulting engineers slowed down construction considerably. Observers of the Mutiny such as William H. Russell were conscious of how much of a difference an operational railroad network would have made in reducing the violence and internal unrest. As the newspaper correspondent remarked in a diary entry:

One is weary of thinking how much blood, disgrace, misery, and horror had been saved to us if the rail had been but a little longer here, had been at all there, had been completed at another place. It has been a heavy mileage of neglect for which we have already paid dearly.

During the upheaval, the rebels intentionally targeted railway construction sites as well as existing railroad infrastructure, such as

stations and bridges. In one of these incidents, the mutineers managed to gain possession of a railroad station and reportedly immediately sought to destroy the stationary locomotives by throwing rocks at them. Such acts of vandalism were frequent and caused serious damage to railroad development, especially in northern areas such as Delhi and Cawnpore. The mutineers feared the military potential of the railway. However, their destructive activities were not motivated by opposition to the rail transportation technology, but rather, by strategic interests, general hostility to colonial rule, and widespread frustration towards the economic as well as administrative changes that the British leadership brought about during the mid-nineteenth century. Contrary to denouncing railway development, the rebel-supported Mughal Emperor Bahadur Shah II promised, in a proclamation made at the beginning of the Mutiny, to provide Indian merchants with government-financed tracks and steam carriages once restored to power.[12]

Following the rebellion, the opinion that railways could ensure the internal security of colonial India gained substantial support in Westminster. A parliamentary committee was organized to make railroad development into an imperial priority. In holding the EIC responsible for the delays in construction, the committee decided to make legislative reforms that removed the technical and administrative obstacles, which prevented the rapid construction of railroad tracks. Although colonial India had a mere 325 kilometers of railway in 1855, it possessed over 8000 kilometers by 1870. From 1858 to 1859 alone, more tracks were laid than ever before. By 1871, a transcontinental railway network connecting Bombay, Allahabad, Calcutta, Delhi, and Madras was completed.[13] Thus, driven primarily by Britain's desire to enhance state security in colonial India, the swift and massive railway construction that occurred in turn resulted in the technology becoming a major mode of military transportation on the subcontinent in less than two decades.

The threat of a foreign invasion from Central Asia motivated the British Raj to commence railway development in the North-Western frontier. From the British perspective, the borderlands not only had an inhospitable landscape, but also unsavoury and hostile inhabitants. As an English traveler wrote, "tyranny and insecurity, oppression and violence, reign everywhere all over the country." In his minute of 1853, Dalhousie



asserted that a railway line to the North-Western provinces would enable the government to effectively safeguard its borderlands against invaders from the Kabul frontier. Although the Delhi-Lahore line was extended to Peshawar in 1868, railroad tracks remained mostly absent in the rugged North-West region when the Second Anglo-Afghan War broke out in 1878. The deficiencies in communication and transportation during the conflict highlighted the need for railroads. Indian forces under the command of Major General Earl Roberts barely managed to prevent the conflict from becoming a massacre. In 1880 Afghan forces overwhelmed a British garrison at Maiwand and besieged the surviving soldiers in Kandahar. After a 30-day, 300-mile forced march, Roberts' troops reached Kandahar just in time to rescue the survivors. Furthermore, from the beginning of the rescue operation, needed supplies could not be transported to the frontline. As Roberts complained, "[h]uge stocks of winter clothing, medical comforts, grain, and various requirements of an army... had been brought by rail to Sibi and had there remained for want of transport." [14]

The Second Anglo-Afghan War convinced the British military establishment that strategic railroads were necessary in the North-West. However, the additional fear of Russian intrigue and expansion in Central Asia motivated the British leadership to initiate construction. Since the 1830s, the British had become suspicious of the Russian empire's growing presence and influence in Central Asia. During his term in office, Dalhousie believed that the possibility of an attack from Kabul caused by European instigation could not be ruled out. He urged his colleagues in London "not to lose sight of the necessity of placing some limit to the progress of Russia in Central Asia." In the second half of the century, the so-called "Great Game" escalated. Russia continued to annex territories in Central Asia and, in 1865, commenced the construction of the Transcaspian Railway on its southern frontier. George N. Curzon, the Marquess of Kedleston, ventured to Central Asia in order to investigate the recently expanded 900-mile line firsthand. In the book he subsequently published, *Russia in Central India*, Curzon claimed that Russia's activities within Central Asia were a "serious menace" to British India. He concluded that regardless of Russia's designs upon colonial India, it was imperative that the British leadership "render any hostile intention futile" and ensure that the frontiers of the "most splendid appendage of the Imperial Crown [were] impregnable." [15]

The Russians, however, continued to pose a threat, and their advance to Merv in 1883 was more than the British authorities were willing to tolerate. Believing Merv to be a potential launching point of a Russian assault, they decided that rapid railway development on the frontier was integral to the preservation of a British-ruled India. By 1891, only three years after the Transcaspian line's expansion, Indian railroad tracks had been extended to Chaman, a settlement merely 60 miles from Kandahar. These newly built railway lines radically enhanced the military capability of the British Empire in South Asia. After all, large numbers of armed forces could now reach Afghanistan in three days from Karachi, a port city that was itself by steam vessel only twenty-five days from Britain. At the turn of the century, Curzon, as the new Viceroy of India, supervised the continuation of railroad expansion in the North-West. As he confirmed in 1902, the purpose of railroad construction in the frontier remained "to strengthen [the British Raj's] position and to enable [it] to move troops without delay in the event of trouble." [16] Therefore, in less than ten years after the Russian annexation of Merv, the defensibility of a vulnerable borderland had been (and continued to be) radically improved through the speedy and large-scale development of railroads.

### *The Railway and its Political Application*

Besides having a military purpose, railroad construction served to justify ideologically the existence of colonial India. For British policymakers, the railway physically embodied the civilizing mission, an ideology that sustained the assumption that they had the right to govern, arbitrate disputes, and insist upon deference. Dalhousie was convinced that the establishment of railways would lead to a "similar progress in social improvement that has marked... various Kingdoms of the Western World." Following the Mutiny, railway development on the subcontinent continued to be associated with the fulfillment of Britain's civilizing mission. In 1868, Robert Cecil, the Marquess of Salisbury and a member of the House of Lords in Westminster at the time, looked upon railway construction as enabling Britain to fulfill its duty of "propergat[ing] civilization in the most peaceful and most harmless way." Moreover, at the turn of the century, Curzon insisted that railroad development had always been a "blessing," and in being the "most unifying agency" in South Asia, served to elevate the material and social condition of all Indians. [17]

British public opinion also perceived railway development as the realization of the civilizing mission. In 1855, the newspaper *Friends of India* reported that the completed railroads were “producing a social change in the habits of general society far more deep... than any which has been created by the political revolutions of the last twenty centuries.” During the Mutiny, an article in *The Economist* hailed the railroad as being the pathway to English science, religion, arts, and opinions for a people that were “miserably poor and wretched” and “like young children,” without a “distinct idea what they want[ed].” Generally, contemporary commentators agreed that railroad development in South Asia was elevating the Indian masses from ignorance and poverty. According to Captain Edward Davidson, an engineer for the government of Bengal, the steam engine in colonial India was:

[O]verturning prejudices, uprooting habits, and changing customs as tenaciously held and dearly loved almost as life itself. A sacred Brahmin now sits in third-class carriage in contact with a Dome (the lowest caste of Calcutta, employed in killing dogs and burying the dead).

Dalhousie’s biographer concurred when he described the fast railway as dealing a “fatal blow to the slow deities of paganism” and consequently causing “other thoughts to arise at the shrine of Parvati or Shiva than the Veds and Shastras inculcate.” Although sceptical of Britain’s supposed good intentions, even Karl Marx, in the capacity of a journalist, believed that the railways would inevitably lead to socioeconomic improvement on the subcontinent. He predicted that “[m]odern industry, resulting from the railway system, will dissolve the hereditary divisions of labor, upon which rests the Indian castes, those decisive impediments to Indian progress and Indian power.”[18]

Criss-crossing almost every part of the subcontinent, railroads undeniably reshaped the day-to-day lives of Indian inhabitants. By the turn of the century, most towns and cities possessed a railway terminus made from stone and marble. The rural populace had not only become accustomed to the sight of tracks, tunnels, and bridges, but also the locomotives and numerous travelers that regularly used them. Possessing more railroad lines than any other network outside of Europe and North America, the Indian railway network encouraged, on a monthly basis alone, the constant interaction of tens of millions of people that lived vast distances apart and came from very different backgrounds.

Moreover, people of all classes had come to rely on this affordable mode of transportation to seek educational and employment opportunities not available in every part of the subcontinent.[19]

Nevertheless, the rhetoric of the civilizing mission often exaggerated the railway's socio-cultural impact. Contrary to the widely accepted opinion of his fellow countrymen, G. O. Trevalyan, a British civil servant, observed that, not far beyond the active tracks, all evidence of Western civilization vanished. Instead, one would typically glimpse an unaltered countryside where the sight of traditional village life, child brides, pilgrims, and "debauched" beggars remained the norm. Moreover, although upper caste Indians were willing to sit beside lower caste ones in third-class carriages, the use of railway lines did not serve to weaken Hindu devotion to 'slow' deities and Vedic traditions. To the contrary, thousands of devotees came to rely upon them to perform *yatras* (pilgrimages to distant shrines and venerated sites) and to attend *melas* (festivals). Before the existence of the railroads, it was difficult for most of them to participate in these religious practices because of the expense and limitation of pre-existing forms of transportation.[20]

Railroad development was also used by the British colonial administrations to facilitate the formation of the modern Indian colonial state. In compressing time and space between far-flung regions as well as establishing links where none before had existed, the railways allowed for the British Raj to establish its authority over the entire subcontinent. The railroads were engineered to be a "network of iron" that enabled a single government to manage diverse territories, lands, and peoples. From the beginning of railroad development, policymakers were aware of how the railroad could be utilized to organize Britain's South Asian holdings into a unified state with a centralized government. As Dalhousie stated in his minute of 1853:

[A] single cast upon the map recalling to mind the vast extent of the Empire we hold... will suffice to show how immeasurable are the political advantages to be derived from a system of communication which would admit of full intelligence of every event being transmitted to the government under all circumstances, at a speed exceeding five-fold its present rate.

Commentators were also enthusiastic about what the railroad could accomplish. Marx envisaged the railway as allowing the British to unify a subcontinent that was supposedly socially and politically broken up into "disconnected atoms" of isolated self-sufficient villages. Similarly, Dalhousie's biographer imagined that through the railway, the British could "do what [past] dynasties ha[d] never done-what the genius of Akbar the Magnificent could not effect by government, nor the cruelty of Tip[u] [S]ahib by violence; they may make India a nation." [21]

For native inhabitants, the complexity, scale, and power of the railway symbolically and physically manifested Britain's imperial presence and dominance within South Asia. Along with displaying the latest advances in metallurgy and industrial machinery (e.g., the steam engine), railroad tracks literally entrenched British colonial authority into the landscape itself. While railway lines reshaped vast tracts of land, the bridges built for them, made from brick, iron, and later steel, were in themselves public exhibitions of Britain's engineering abilities. Unsurprisingly then, the introduction of railways had a desirable effect on a populace that the British colonial regime sought to govern and recruit. The active railway initially both terrified and awed the Indians. According to John Brunton, a chief resident engineer of British India during the mid-nineteenth century, the Karachi natives that first heard and saw the locomotive train were astounded and could not understand what hidden power enabled it to drag such enormous loads. Some "feared them" and in "supposing that they moved by some diabolic agency, they called them Shaitan (or Satan)." Moreover, as writer and journalist Harriet Martineau vividly described:

[V]illagers [from under the mountains of the West Ghats] come out at the sound of the steam whistle, and the babies gasp and cry when the train rushes by; and nobody denies that the railway is a wonderful thing. [22]

By inspiring a belief in British superiority amongst the Indian populace, railway development effectively served to spread and consolidate British supremacy over the entire subcontinent, including the so-called "independent Native states." Consider the situation that transpired within the principality of Bahawalpur in 1863. The Newab was on unfriendly terms with the British on account of his alleged "tyranny and grievous cruelty to his subjects," and "very few Englishmen and certainly no white lady" had ever been granted permission to travel through his realm.

Desiring to construct the Indus Valley railway route that happened to pass through Bahawalpur, Brunton and a following composed of a "faithful lot of servants and soldiers" managed to *persuade* the ruler diplomatically to grant them permission to survey the lands within his territory. The entry of so large a group of outsiders into the realm had a strong impression on the Newab's subjects. Although Brunton saw his mission as strictly being railroad business, the inhabitants considered him to be an "[e]missary from the Indian government sent to endeavour to redress their grievances" and representatives from a "party in the state most anxious for the displacement of their oppressor" sought his audience in the nights. After Brunton's departure, plots began taking shape in the principality and the Newab was soon after assassinated. When this occurred, the British leadership took control of the situation without any resistance. According to the engineer:

[They] stepped in, appointed an English officer as Regent—took the young Prince under its care, gave him a first class education, [and took measures to ensure that] he by no means follow[ed] in his father's footsteps.[23]

Thus, in viewing the railroad as furthering imperial ideology and utilizing it to create colonial India, the British encouraged rapid and large-scale railway development.

### *The Railway and its Economic Application*

For railway promoters, the profit-making potential of the railway in British India was too lucrative to disregard. According to Stephenson, the second consideration for constructing the Mirzapore railway route was to:

[P]rovide a means of conveyance from the interior to the nearest shipping ports of the rich and varied products of the country, and to transmit back manufactured goods of Great Britain... in exchange.

Along with passing through areas of military importance, the railroad tracks would connect locations of commercial significance. Promoters also endeavoured to make railway construction a money-making enterprise and a profitable investment for Western financiers. Hence, promoters like Stephenson campaigned for a state guarantee. A state guarantee entailed the Indian government compensating a percentage of interest to investors in case the annual surplus of railway revenue was

insufficient. The promoters knew that they could not raise the amount of capital required to initiate railway construction without providing a state guarantee of an annual fixed rate of interest to public investors. Moreover, they were aware that the railway developers would consider the financial risks too great without obtaining a state guarantee.[24]

Although promoters used the railway's ability to transport other raw materials from South Asia, such as jute and tea, to encourage investment, they focused more of their campaign on the advantages it would bring to the cotton plantations in the Deccan. Following the American cotton famine of 1846, promoters presented the railway as being a means to reduce Britain's dependence on US cotton and making British India into a profitable cotton supplier. For instance, Hyde Clarke, a writer and railway promoter, argued that the construction of railroads on the subcontinent would eliminate Britain's need for US cotton and complained about how existing transport in colonial India only enabled it to supply one-twelfth of Britain's cotton imports. He concluded that if railways were developed in British India, it would be possible to import enough Indian cotton to supply "hundreds of thousands of people in England with the means of subsistence" and to stimulate Indian agriculture and industry.[25]

Unsurprisingly, the railway promoters gained the endorsement of the British cotton manufacturers. During the 1840s, 80% of British cotton was imported from the US. This situation was perceived as dangerous, since the availability of cotton in Britain was largely determined by domestic factors in the United States. Importantly, as demonstrated during the American cotton famine of 1846, crop failures in the US could prove costly to the British textile industry. Although the manufacturers desired to import cotton in bulk from the plentiful cotton districts of the western Deccan, the existing form of transportation made it difficult. Bullocks could only travel sixteen kilometers a day and cotton bales frequently were ruined by rain and dust. The manufacturers viewed this situation as intolerable and threw crucial support behind the railway promoters. One after another, the chambers of commerce in textile-producing areas such as Lancashire sent to the Court of Directors strong letters of support for railway development in colonial India. Moreover, in conjunction with British merchants, manufacturers sought to persuade the EIC leadership

through memorials, petitions, newspaper letters, and government motions.[26]

The railway campaign was also supported by the British media and the Anglo-Indian business community. As an advocate for the introduction of railways in colonial India, the editor of the *Times* utilized the newspaper to promote his cause to the public. For example, an article assured its readers that the railway would transport to Britain the "worth of a ship-load of diamonds in the Cotton-fields of the Deccan." This optimism towards the railroad was also echoed in columns of the *Economist*. In 1847, the newspaper declared that the railroad would benefit a country so "densely peopled" and "rich in spontaneous productions" by making "her the cotton field of Europe." The Anglo-Indian business community was also sympathetic to the cause. During his visit to British India in 1844, Stephenson gained the confidence of both European and Indian members of the Calcutta business elite. In particular, they were enticed by the time- and cost-saving that railways would provide their day-to-day operations. After all, a railway line between Calcutta and Benares would hypothetically enable a Calcutta merchant to reach his destinations in hours rather than days or weeks, and cost at the most ten pounds rather than at least forty pounds. Thus, prominent businessmen such as Dwarkanath Tagore strongly endorsed railway construction. The Bengali entrepreneur was "very desirous" to have a railway to his collieries from Calcutta and even willing to "raise one-third of the capital for this portion of the line if undertaken immediately." [27]

The commercial interest groups behind the railway campaign, most notably the cotton manufacturers, heavily influenced the decision-making of policymakers. Without the support of the manufacturers, the railway developers would never have secured a contractual agreement with the Court of Directors on August 17, 1849, that stipulated a state guarantee of five percent to investors. As railway promoter John Chapman reported to share holders of the Great Indian Peninsular Railway (one of the two railroad developers), the manufacturing districts of the north prevented the premature death of the railroad by obtaining the "favourable consideration" of the Court of Directors. Furthermore, the manufacturers had powerful political allies such as Charles Wood, the president of the Board of Control (the parliamentary body which



supervised the EIC). In a letter to the Governor-General, Wood asserted that the railroad could serve as a "great national project" if it travelled through cotton country on the subcontinent since it would eliminate Britain's need for US cotton. The colonial authorities were primarily interested in how the railroad would increase the country's military efficiency and decrease its expenditures. However, the Governor-General also endorsed the commercial interests behind large-scale railroad development in his popular minute of 1853. In agreement with Wood's proposal, Dalhousie drew favourable attention to the cotton motive. He proclaimed that:

The commercial and social advantages which India would derive from their establishment are, I truly believe, beyond all present calculation. Great tracts are teeming with produce which they cannot dispose... *England is calling out aloud for the cotton [which India] would produce sufficient in quality and plentiful in quantity...* [and there is] an increased demand for articles of European produce in the most distant markets of India [italics added].[28]

Consumer appeal among the Indian populace for railway transportation was unanticipated by railroad advocates and became an additional source of profit. When Stephenson began campaigning for the introduction of a railway in colonial India, the Court of Directors doubted that the railway would attract much traffic. However, within the first year of railway activity, 450,000 people travelled by rail. In July 1854, Dalhousie reported that though "many doubted whether the natives would go on the railway," the recently opened Bombay line had been "crowded for th[e] [first] three days by Calcutta Baboos" and "engaged thousands deep." By 1863, the "fire-carriages" were carrying more than a million passengers per year and made a substantial contribution to the annual railway revenue. Indian enthusiasm for the newly built railroads was all too evident. However, it should be noted that during the mid-nineteenth century, railway construction sites and completed lines had also become public spaces where Indians were subordinated to the will of the British by the threat or use of violence. When Brunton asked a British foreman overseeing a railway construction site how he managed to instruct the five hundred Indian labourers under his supervision, the foreman replied: "I tell these chaps three times in good plain English, and if they don[']t understand that, I takes the lurki (the stick) and we get on very

well." The engineer himself had no qualms about the use of violence against Indian insubordination. As he later goes on to describe:

An hour before the time of a train starting, crowds of natives surrounded the booking office clamouring for tickets, and at first there was no keeping them to the inside of the carriage. They clambered up on the roofs of the carriages and I have been obliged to get up on the roofs and whip them off.[29]

Although the colonial leadership possessed decision-making power, the commercial interest groups continued to shape heavily the Indian railway policy. Until 1870, the cotton manufacturers and other business groups encouraged railway development that would be to their advantage. For instance, the Manchester Commercial Association, Oriental Bank, and other bodies managed to persuade the Court of Directors to sanction a line spanning from Bombay to Ahmadabad. The business groups, especially the manufacturers, depended on powerful political allies such as Wood and various British Members of Parliament to influence the British Raj to support the construction of desired railways. Following the Mutiny, favourable government reforms, the profit to be generated by transporting goods, and consumer demand motivated the formation of additional guarantee railway companies. The developers preferred railroad routes that would generate the highest commercial traffic. In a political setting where at one point there were 156 railway directors in the British House of Commons and Lords, the railway companies easily obtained government authorization for their endeavours. During the 1870s, the Indian government sought to impose full state control over all railroad development. However, commercial groups in London were able to thwart this attempt through the support of Salisbury, the new Secretary of State for India. In 1874, Salisbury renegotiated the contracts of old guarantee companies on even more favorable terms without consulting the colonial leadership in British India. Furthermore, he ruled in 1879 that the Indian government could only build strategic lines to the North-Western frontier whereas railway development elsewhere would once more be privatized.[30] Therefore, in viewing railroads as a lucrative enterprise, the British facilitated fast and massive railway development.

As economic historian Romesh Dutt initially asserted in his work, *The Economic History of India*, railroads, until the turn of the century, were

a “permanent loss to the government year after year.” Although the railway lines were collecting revenue from transporting passengers and cargo, none of them, with the exception of one, were earning enough to pay the five-percent dividend promised to investors. Consequently, the Indian government constantly needed to compensate the railway shareholders. Although the initial costs of railway construction during the 1860s and 1870s partially prevented the companies from being able to cover the guarantee, it was their extravagant spending that decisively burdened Indian taxpayers. Following the Mutiny, government reforms removed state restrictions on fast and expensive railway construction. The lessening of government regulation along with the financial security of the state guarantees encouraged railway companies to build profitless railroads and use expensive materials. Consequently, the Indian exchequer paid out a total of fifteen million pounds by 1869. This situation compelled John Lawrence, the Viceroy of India at the time, to complain about how the “whole profits go to the Companies and the whole loss to the Government.” In accusing the railroad developers for making this profit by “bad and extravagant” management, the Viceroy urged that railway construction be fully state controlled. Lawrence and his successors did manage to temporarily lower the expense of railway development, but their efforts to maintain state control were soon undermined by inadequate state funds and the political intervention of Salisbury. In continuing to spend excessively, the railroad developers compelled the Indian government to pay out an alarming total of 50 million pounds by the end of the century. The Curzon administration oversaw an unprecedented surplus in railway revenue that eliminated the need for the withdrawal of capital from the Indian treasury. However, the Viceroy’s claim that the railroads were profit-making was misleading since the surplus made in railway revenue primarily resulted from the intentional disregard of railway upkeep. This negligence caused the quality of railway service in terms of comfort, convenience, and efficiency to dramatically deteriorate. Thus, although the Indian railway policy was beneficial to commercial groups and ensured the rapid creation of one of the world’s largest railway networks, it proved to be costly to the Indian state.[31]

Despite being beneficial to British commercial interests, railway development negatively affected industrial growth in South Asia. Desiring to make colonial India into an agricultural supplier, as well as a

market for manufactured goods, railway developers constructed railroads with the intention to make the interior of the subcontinent accessible and to integrate the country into a global economy. Changes to the global market for primary products, especially after the American cotton famine, led to the development of a railroad network that connected agricultural regions to the seaports. Facilitated by the railroad, this rapid integration into the global economy caused the decline of pre-existing manufacturing industries. Consider the Indian textile industry, which was a lucrative enterprise that did not rely on machinery, but instead on low-cost labor, easy access to cotton, and skills of spinners, weavers, and dyers. By enabling industrial cotton manufacturers to import a flood of cheaper textiles to the subcontinent, the railways undermined the centuries-old industry and the prosperity of numerous urban centers. The majority of cotton weavers soon found it necessary to either abandon their trade or accept a marginal and destitute position in Indian society. As Marx acknowledged, British "steam" did not only result in the economic decline of Indian towns that had produced admirable fabrics. In uprooting the unique relationship between agriculture and manufacturing industries on the subcontinent, the railway caused an exporting country to become an importing one, produced unprecedented misery for Indian commerce, and left the "bones of cotton weavers [to] bleac[h] the plains of India." [32] Hence, while making it technologically possible for South Asia to participate in a modern global economy, the swift development of railroads destroyed local sources of prosperity in the region.

Contrary to Dalhousie's and Marx's predictions, railway development impeded rather than encouraged the growth of modern industry in colonial India. The transfer of modern industrial technology during the nineteenth century was primarily profit driven. Moreover, as 99% of the capital for the railways was raised in Britain, the decision-makers of the railroad companies were almost exclusively British. Consequently, the self-interest of the British investors in combination with an inflexible colonial railway policy in British India made railroad construction an obstacle to industrialization. Although colonial India possessed metal deposits required to produce manufacturing plants similar to European ones, the raw materials were mainly located in isolated and sparsely populated regions of the subcontinent. Railroad developers already had easy access to densely populated regions with high commercial traffic

and an ample supply of cheap labor. Furthermore, it was far more profitable for them to import most of the industrially manufactured materials from Britain than to develop and exploit the metal-producing regions on the subcontinent. Colonial administrators were paralyzed by the financial responsibility for the expensive state guarantees and the prevailing will of British commercial groups with the political backing of Salisbury. The administration, thus, was unable to endorse policies that would burden the Indian government with the cost of constructing industrial plants capable of producing manufactured goods and machinery. Therefore, although colonial India obtained a transcontinental railway network that revolutionized the speed of transportation on the subcontinent, it remained without the infrastructure to sustain it or the manufacturing base required to stimulate industrial development.[33]

In successfully opening colonial India to world trade and transforming it into an international supplier of agricultural goods, the railways also had a detrimental impact on the welfare of the Indian population. By the late-nineteenth century, the demand for cotton declined and British India had become a major wheat exporter. However, in penetrating the entire subcontinent and encouraging the over-production of agricultural goods, the railways played an integral role in simultaneously depressing the price for wheat abroad and rendering it beyond the affordability of the Indian poor. Until the First World War, this price explosion caused frequent famines in which staggering numbers of people in drought-stricken areas and even well-watered districts starved to death.[34]

Changes in Indian rural societies brought about by railway development contributed to the plight of poor inhabitants. After all, the integration of vast areas of the subcontinent into the global economy, facilitated by railroad construction, caused traditional self-subsistent Indian village communities to rapidly dissolve. They were not replaced by urban or industrial centers, but rather, increasingly by village units in which the dominant agents were absent rent-receiving landlords, aggressive moneylenders, crop merchants, and grain price speculators. Consequently, the bulk of the rural population was reduced to the status of dependent tenants and landless laborers vulnerable to the impersonal business transactions of a globalized agricultural market. During this period, millions of Indians reached a stage of malnutrition that modern

health workers identify as skeletonization. Although the railroads were hailed by policymakers as a safeguard against famines, they were instead used with government support by Anglo-Indian merchants to transport grain supplies from drought-stricken areas to central depots for hoarding, exportation, and protection against grain riots. Unsurprisingly then, the statistician Arthur Connell complained in 1885 that the Indians were "told to be grateful for the boon of free trade" that the railroads facilitated, and yet found their income "smaller" and food "dearer." [35]

As the historian Mike Davis asserts, the colonial regime's willingness to allow enormous spending on railway construction compared to its abandonment of needed agricultural development indicated its misplaced priorities. The railroad system consumed thirteen times as much investment as all of the hydraulic works until 1880. This situation compelled the pro-irrigation lobby led by Arthur Cotton and Florence Nightingale to protest during the 1876-1877 famine that:

[W]e have before our eyes the sad and humiliating scene of magnificent work that cost poor India 160 millions, which are so utterly worthless in respect of the first want of India, that millions are dying by the side of them.

From 1885 to 1895, a mere 20% of the public work expenditure was devoted to irrigation development. Most of the funds went into projects that would generate the highest financial returns, such as sugar cane fields, instead of a sufficient supply of grain to offset the effects of price fluctuations and food shortages. By 1902, only 24 million pounds had been spent on irrigation works, as opposed to the 226 million pounds spent on railways (at least 50 million of which had been spent by the Indian government to subsidize the state guarantees). [36] Thus, the rapid construction of railways in British India did not result from a uniform transfer of advanced technologies from Britain. On the contrary, the swift development of railroad infrastructure received more priority than the introduction of other technologies on the subcontinent.

### *Conclusion*

This study has discussed why and how British authorities motivated large-scale railway development in British India. The British Raj motivated the transfer of technology from Britain to colonial India in order to consolidate British imperial interests on the subcontinent.

Historical assessments of South Asia's colonial past are often overshadowed by rigid analyses, including those that explore how we should understand the history of technological transfer from Britain to colonial India. It is my hope that my investigation, and those of other scholars, will explain how British India simultaneously experienced rapid technological advancement in some areas and a dramatic retreat from technological progress in others.

[1] Ian Inkster, "Colonial and Neo-Colonial Transfers of Technology: Perspectives on India before 1914" in *Technology and the Raj: Western Technology and Technical Transfers to India, 1700-1947*, ed. Roy MacLeod and Deepak Kumar (New Delhi: Sage, 1995), 34-43; Ian Derbyshire, "The Building of the India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920," in *Technology and the Raj*, ed. MacLeod and Kumar, 200-203.

[2] Daniel Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: Oxford University Press, 1981), 129-164; Daniel Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York: Oxford University Press, 1988); 4-7.

[3] Historian Roy MacLeod proposes an alternative historiographic perspective to that offered by Headrick. See Roy MacLeod, "On Visiting the "Moving Metropolis": Reflections on the Architecture of Imperial Science," in *Scientific Colonialism: A Cross-Cultural Comparison*, ed. Nathan Reingold and Marc Rothenberg (Washington, D.C.: Smithsonian Institution Press, 1987), 217-250. MacLeod explores three significant themes of his own. First, science did not belong to any one society but rather was cosmopolitan, absorbing and assimilating information and ideas from a variety of sources and locations. The flow of scientific-technical knowledge between Western societies and non-European societies is understood as having been a multi-faceted, two-way process. Secondly, the periphery was used as a "social laboratory" by a spatially unfixed metropolis. The findings from these "experiments" influenced metropolitan theoretical positions on topics ranging from understanding the structure of the Earth to ways of improving the efficiency of various institutions. Lastly, changes in the political situation of the British Empire directly impacted the way that the scientific-technological metropolis manifested itself. For instance, the transition from the so-

called "metropolitan science" phase (1780-1820s) to the alleged "colonial science" (1830-1874) phase occurs as a result of the British Empire losing its American colonies and subsequently directing its focus on territorial expansion. This transition involved the metropolis changing from being centered almost exclusively in Western Europe to extending into non-European lands (i.e., South Asia). Admittedly, MacLeod, unlike Headrick, recognizes the diversity and dynamism within the periphery. However, he only superficially evaluates the technological dimension of modern science and bases his analysis mostly on the historical situation of Australia. In contrast, Headrick not only focuses on technology, but also derives his approach mainly from a historical understanding of technological development in colonial India.

[4] Ranajit Guha, "On Some Aspects of the Historiography of Colonial India," in *Selected Subaltern Studies*, ed. Ranajit Guha and Gayatri Chakravorty Spivak (New York: Oxford University Press, 1988), 37-44. For examples of the transfer of technology, see Michael Adas, *Machines as the Measurement of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca, NY: Cornell University Press, 1989) and Deepak Kumar, "Developing a History of Science and Technology in South Asia," *Economic and Political Weekly* 38: 23 (2003).

[5] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton, NJ: Princeton University Press, 1999), 160.

[6] Headrick, *The Tentacles of Progress*, 55; Derbyshire, "The Building of the India's Railways," 185-200; Arnold, *Science, Technology, and Medicine in Colonial India*, 111; Fritz Lehman, "Railway Workshops, Technology Transfer, and Skill Labour Recruitment in Colonial India," *Journal of Historical Research* 20 (1977): 49-61.

[7] Headrick, *The Tentacles of Progress*, 70, 75

[8] George Huddleston, *History of the East Indian Railway* (Calcutta: Thacker, Spink, and Co., 1906-1939), 2; Headrick, *The Tentacles of Progress*, 59; Rowland Macdonald Stephenson, *Report upon the practicability and advantages of the introduction of railways into British India...* (London, 1845), 7 (first quotation); Daniel Thorner, *Investment in Empire: British Railway and Steam Shipping Enterprise in India 1825-1849* (Philadelphia: University of Pennsylvania Press, 1950), 47-48; William Patrick Andrew, "Political and Military Importance of the



Railways in India," *Indian railways as connected with the power and stability of the British Empire in the East...* (2nd ed. London, 1846), 125-127 (second quotation), 138-142 (third quotation).

[9] W. J. Macpherson, "Investments in Indian Railways, 1845-1875," *The Economic History Review* 8: 2 (1955), 179; Edward Davidson, *The Railways of India: With an Account of Their Rise, Progress, and Construction. Written with the Aid of The Records of the India Office* (London: E & F. N. Spon, 1868), 56-57 (quotation), 226; "Copy of memorandum by Major Kennedy, on the question of a general system of railways for India," *Parliamentary Papers* 1854 (131): 4; Thorner, *Investment in Empire*, 62-64.

[10] Headrick, *The Tentacles of Progress*, 60-61; Davidson, *The Railways of India*, 72-73; "Copy of memorandum by Major Kennedy," *Parliamentary Papers* 1854 (131): 3-5 (first and second quotations).

[11] William Wilson Hunter, *Rulers of India: The Marquess of Dalhousie: and the Final Development of the Company's Rule* (Oxford: Clarendon Press, 1895), 191-193; James Andrew Broun Ramsay Dalhousie, *Private letters of the Marquess of Dalhousie* (Edinburgh: London, W. Blackwood and Sons, 1910), 279; "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India, relative to railway undertakings in that country," *Parliamentary Papers* 1852-1853 (787): 114-115 (first and second quotations), 118 (third quotation); Davidson, *The Railways of India*, 80-89; Headrick, *The Tentacles of Progress*, 64.

[12] Hunter, *Rulers of India*, 191; Headrick, *The Tentacles of Progress*, 65-66; William Howard Russell, *My Diary in India: in the Year 1858-1859*, 2 vols. (London: Routledge, Warn, and Routledge, 1860), 1:154-155 (quotation); Huddleston, *History of the East Indian Railway*, 19-20; Ian J. Kerr, *Building the Railway of the Raj: 1850-1900* (New Delhi: Oxford Printing Press, 1997), 36; John Brunton, *John Brunton's Book: Being the Memories of John Brunton, Engineer, from a manuscript in his own hand written for his grandchildren* (Cambridge: Cambridge University Press, 1939), 105; Ira Klein, "Materialism, Mutiny, and Modernization in British India," *Modern Asian Studies* 34 no. 3 (2000): 545-580; Arnold, *Science, Technology, and Medicine in Colonial India*, 123-124. At

the time of the Indian Mutiny, Indians had a generally menial role in the British railroad system. However, by the late nineteenth-early twentieth century, Indians began assuming skilled positions, such as conductors and engineers.

[13] Macpherson, "Investments in Indian Railways, 1845-1875," 179; Davidson, *The Railways of India*, 110-111; Headrick, *The Tentacles of Progress*, 58, 65-66; Robert Kubicek, "British Expansion, Empire, and Technological Change," in *The Oxford History of the British Empire: Volume III: The Nineteenth Century*, ed. Andrew Porter (New York: Oxford University Press, 1999), 251.

[14] Sarah Searight, *Steaming East: The Forging of steamship and rail links between Europe and Asia* (London: Bodley Head., 1991), 205-206 (first quotation), 209-211; "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India," *Parliamentary Papers 1852-1853 (787)*: 117-118; Macpherson, "Investments in Indian Railways, 1845-1875," 179; Fredrick Roberts, *Forty-One Years in India from Subaltern to Commander-in-Chief* (London: Macmillan and Co., 1908), 468-472, 478-495 (second quotation on 493).

[15] Searight, *Steaming East*, 206, 211-213; "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India," *Parliamentary Papers 1852-1853 (787)*: 118; Dalhousie, *Private letters of the Marquess of Dalhousie*, 324 (first quotation); George N. Curzon, *Russia in Central Asia in 1889 and the Anglo-Russian Question* (London: Longmans, Green, and Co., 1889), 34-35, 319 (second quotation), 13-14 (third quotation); Nayana Goradia, *Lord Curzon: The Last of the English Moghuls* (Delhi: Oxford University Press, 1993), 100.

[16] Searight, *Steaming East*, 213, 220, 222; Curzon, "Frontier Policy: Durbar at Peshawar, April 26, 1902," in *Lord Curzon in India*, 422, 425 (quotation).

[17] Adas, *Machines as the Measurement of Men*, 204, 224 ; "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India," *Parliamentary Papers 1852-1853 (787)*: 115; Macpherson, "Investments in Indian Railways, 1845-1875," 177; Robert Cecil quoted in Macpherson, "Investments in Indian Railways, 1845-1875," 177 (first quotation); Curzon, "Administrative and Financial Progress:

Third budget Speech (Legislative Council at Calcutta), March 27, 1901," in *Lord Curzon in India*, 81-85 (second quotation). In the railway system of colonial India, Indians were employed almost exclusively for non-technical duties until the twentieth century. Managerial and technical positions were dominated by individuals of British and/or Anglo-Indian origin. On a related point, it can be asserted that the hierarchy within the Indian railway reinforced the existing post-1857 colonial status quo rather than elevating the socio-economic status of Indians to a level similar to that of Britons.

[18] *Friends of India* cited in Headrick, *The Tentacles of Progress*, 63 (first quotation); *The Economist*, 25 July 1857, 810-811 (second quotation); Davidson, *The Railways of India*, 3 (third quotation); Arnold Edwin, *The Marquis of Dalhousie's administration of British India*, 2 vols. (London: Saunders, Otley, and Co., 1862-1865), 2:241 (fourth quotation); Karl Marx, "The Future Results of British Rule in India," in *Dispatches for the New York Tribune: Selected Journalism of Karl Marx*, ed. James Ledbetter (London: Penguin Books Ltd., 2007), 222-223 (fifth quotation).

[19] Arnold, *Science, Technology, and Medicine in Colonial India*, 110; Headrick, *The Tentacles of Progress*, 58, 123.

[20] G. O. Trevelyan, "An Indian Railway," *The Competition Wallah* (London: Macmillan and co., 1864), 26, also mentioned in Adas, *Machines as the Measurement of Men*, 228; Headrick, *The Tentacles of Progress*, 123.

[21] Prakash, *Another Reason*, 166; Dalhousie, *Private letters of the Marquess of Dalhousie*, 324 (first quotation); "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India," *Parliamentary Papers 1852-1853* (787): 115 (second quotation); Marx, "The Future Results of British Rule in India," 220-222 (third quotation); Edwin, *The Marquis of Dalhousie's administration of British India*, 2:241-242 (fourth quotation).

[22] Adas, *Machines as the Measurement of Men*, 204, 221-224; Prakash, *Another Reason*, 168; Derbyshire, "The Building of the India's Railways," 184-200; (first quotation); Headrick, *The Tentacles of Progress*, 66; Brunton, *John Brunton's Book*, 105 (second quotation); Harriet Martineau, *British Rule in India: A Historical Sketch* (London: Smith, Elder, and Co., 1857), 340 (third quotation).

[23] Headrick, *The Tentacles of Progress*, 69 (first quotation); Brunton, *John Brunton's Book*, 128-129 (second and third quotations), 136 (fourth quotation); 144-145 (fifth quotation).

[24] Stephenson, *Report upon the practicability and advantages of the introduction of railways into British India*, 7 (quotation); Thorner, *Investment in Empire*, 47; Ira Klein, "Materialism, Mutiny, and Modernization in British India," *Modern Asian Studies* 34:3 (2000), 553; Macpherson, "Investments in Indian Railways, 1845-1875," 177, 180; Davidson, *The Railways of India*; 38-39; Headrick, "The Railroads of India," 183.

[25] Macpherson, "Investments in Indian Railways, 1845-1875," 180. Zaheer Baber, "Colonizing nature: scientific knowledge, colonial power and the incorporation of India into the modern world-system," *British Journal of Sociology* 52:1 (2001), 51; Headrick, *Tentacles of Progress*, 182; Hyde Clarke, *Practical and theoretical considerations on the management of railways in India* (n.p.: 1847), 41 (quotation).

[26] W. J. Macpherson, "Investments in Indian Railways, 1845-1875," 182.

[27] *The Times*, 14 June 1847, 4 (first quotation); Headrick, *Tentacles of Progress*, 59-60; *The Economist*, 28 August 1847, 982 (second quotation); Thorner, *Investment in Empire*, 47; *The Economist*, 26 February 1848, 238; Stephenson, *Report upon the practicability and advantages of the introduction of railways into British India*, 48 (second quotation), 53.

[28] Macpherson, "Investments in Indian Railways, 1845-1875," 179, 182, 184; East India Company, *Contract*

*between the Honorable East India Company and the East Indian Railway Company* (n.p.: 1849), 12, 182, 184 (first quotation); Charles Wood quoted in Headrick, *The Tentacles of Progress*, 60 (second quotation), 64-65; "Copies or extracts of correspondence received by the last mail from the Governor-General in council in India, relative to railway undertakings in that country," *Parliamentary Papers* 1852-1853 (787): 114-115 (third quotation); "Copy of memorandum by Major Kennedy, on the question of a general system of railways for India," *Parliamentary Papers* 1854 (131): 3-4.

[29] Davidson, *The Railways of India*, 37; Satpal Sangwan "Indian Response to European Science and Technology 1757-1857." *The British Journal for the History of Science* 21:2 (1988), 221; J. A. B. R. Dalhousie, *Private letters of the Marquess of Dalhousie*, 314 (first quotation); Edwin, *The Marquis of Dalhousie's administration of British India*, 2:239-240; Bruton, *John Brunton's Book*, 107 (second quotation), 109 (third quotation).

[30] W. J. Macpherson, "Investments in Indian Railways, 1845-1875," 184-185; *The Economist*, 6 August 1859, 879; *The Times*, 29 October 1868, 9; Edwin, *The Marquis of Dalhousie's administration of British India*, 2:239; Headrick, *The Tentacles of Progress*, 65, 72-74; David Thorner, "Capital Movement and Transportation: Great Britain and the Development of India's Railway," *The Journal of Economic History*. 11:4 (1951), 393.

[31] Romesh C. Dutt, *The Economic History of India In the Victorian Age: From Accession of Queen Victoria in 1837 to the Commencement of the Twentieth Century* (London: K. Paul, Trench, Trübner, 1900), 174 (first quotation) , 177, John Lawrence quoted at 353 (second quotaton); 354-355; Edwin , *The Marquis of Dalhousie's administration of British India*, 2:239-240; Thorner, "Capital Movement and Transportation," 393-394; Davidson, *The Railways of India*, 110-111; W. J. Macpherson, "Investments in Indian Railways, 1845-1875," 185; Headrick, *The Tentacles of Progress*, 65, 71- 78, 86; G. N. Curzon, "Commerce and Industry: Farewell Address from Bombay Chamber of Commerce, November 8, 1905," in *Lord Curzon in India*, 283.

[32] Baber, "Colonizing Nature," 51; David Ludden, "Colonialism and Public Technology: Transportation and

Irrigation in Tamil Nadu Under British Rule" *Science and Technology in South Asia: Proceedings of the South Asia Seminar II: 1981-1982*, ed. Peter Gaeffke and David A. Utz (Philadelphia: Department of South Asia Regional Studies, 1985), 136; Arnold, *Science, Technology, and Medicine in Colonial India*, 95-97; Marx, "The Future Results of British Rule in India," 215-216 (quotation).

[33] Morris D. Morris, "Some Factors Affecting the Rate of Economic Growth and Technical Change in India After 1800," in *Science and Technology in South Asia*, ed. Gaeffke and Utz, 126-129; Thorner, "Capital

Movement and Transportation," 392-393; Inkster, "Colonial and Neo-Colonial Transfers of Technology," 35- 38; Kerr, *Building the Railways of the Raj*, 1-2; Headrick *The Tentacles of Progress*, 74.

[34] A. K. Connell, "Indian Railways and Indian Wheat," 237. W. J. Macpherson, "Investments in Indian Railways, 1845-1875," 184, 237; Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (New York: Verso, 2002), 26-27; B.M. Bhatia, *Famines in India* (Delhi: Konark Publishers PVT Ltd., 1991), 1-2; A. K. Connell, "Indian Railways and Indian Wheat," 160-182, 237-270.

[35] Davis, *Late Victorian Holocausts*, 26-27, 34; Thorner, "Capital Movement and Transportation," 400; G. N. Curzon, "Administrative and Financial Progress: Third Budget Speech (Legislative Council at Calcutta), March 27, 1901," in *Lord Curzon in India*, 84-85; Bhatia, *Famines in India* 240; A K. Connell, "Indian Railways and Indian Wheat," 247 (quotation).

[36] Davis, *Late Victorian Holocausts*, 332; Arthur Cotton and Florence Nightingale, *The Madras Famine* (London: Simpkin, Marshall, & Co., 1877), 5 (quotation); R. C. Dutt, "Railways and Irrigation," 550; Headrick *The Tentacles of Progress*, 76.



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