Engineers in India: Industrialisation, Indianisation and the State, 1900-47

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DECLARATION

This thesis represents my own work. Where the work of others is mentioned, it is duly referenced and acknowledged as such.

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ABSTRACT

This thesis offers a collective portrait of an important group of scientific and technical practitioners in India from 1900 to 1947: professional engineers. It focuses on engineers working in three key sectors: public works, railways and private industry. Based on a range of little-used sources, it charts the evolution of the profession in terms of the composition, training, employment patterns and work culture of its members. The thesis argues that changes in the profession were both caused by and contributed to two important, contested transformations in interwar Indian society: the growth of large-scale private industry (industrialisation), and the increasing proportion of 'native' Indians in government services and private firms (Indianisation). Engineers in the public works and railways played a crucial role as officers of the colonial state, as revealed by debates on Indianisation in these sectors. Engineers also enabled the emergence of large industrial enterprises, which in turn impacted the profession. Previously dominated by expatriate government engineers, the profession expanded, was considerably Indianised, and diversified to include industrial experts. Whereas the profession was initially oriented towards the imperial metropolis, a nascent Indian identity emerged in the interwar period. Throughout, the thesis studies British and Indian engineers in parallel. It also underscores the importance of studying the history of science, technology and medicine in twentieth-century India in relation to the heterogeneous, evolving colonial state. Finally, the focus on practitioners complements the existing historiographical emphasis on intellectuals' debates on science, colonialism, modernity and nation.

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CHAPTER 1

Engineers in India, 1900-47

Putting practitioners at the centre of the history of science, technology and medicine

Introduction

This thesis is a history of engineers working in India in the first half of the twentieth century. Situating the experience of this extremely important, yet under-studied, group of technical practitioners within the political and economic history of the country, the thesis is envisioned as a contribution to the history of science, technology and medicine (HSTM) in India.

Scholarship in Indian HSTM, which has gathered momentum since the 1990s, has thus far focused mainly on the colonial era. The majority of these works deal with the long nineteenth century (extending until World War I), whereas historical studies focusing on science, technology and medicine (STM) in twentieth-century India are relatively rare.[1] The temporal focus of the literature corresponds to its main thematic concerns. In studies of the long nineteenth century, the literature is primarily concerned with understanding the relationship between science and colonialism. Debates in the historiography surround the nature of science in a colony (was it 'Western', 'indigenous', or 'colonial'?) and the manner of its growth (did science 'diffuse' or 'circulate'?). Ultimately, the notions of limitation, dependence, and subordination to the imperial metropolis are dominant in these works. The literature on the twentieth century, including that dealing with the final decades of British rule, is concerned mainly with the role of science and technology in nationalist intellectuals' discourse on the creation of an Indian 'modernity'. The primary actors in this story are usually politicians and scientists (in their role as intellectuals)—Nehru, Gandhi, M.N. Saha, P.C. Ray, J.C. Bose—as opposed to (for instance) engineers, doctors or technicians as practitioners of STM.

While these are undoubtedly important questions, the overwhelming focus on them has had some deleterious historiographical consequences. First, it has led to a comparative neglect of the study of institutions, practices and professional groups in favour of the analysis of the discourses of colonial elites and nationalist intellectuals. Second, it has caused an arguably

[1] As David Arnold writes: 'Despite their obvious importance, the science, technology and medicine of the period between the outbreak of the First World War and Indian independence have, as yet, attracted little scholarship.' Arnold, *Science, Technology and Medicine in Colonial India (The New Cambridge History of India* Vol. III.5*)* (Cambridge: Cambridge University Press, 2000), p. 225.

excessive reliance on the analytical frameworks of 'colonialism' and 'nationalism' in interpreting STM in India, resulting in a starkly dichotomous picture: a nineteenth century characterised by 'tools of imperialism'[2] (and mostly European actors), and a mid-twentieth century by tools of development and nationhood (and mainly Indian actors).[3] Third, it neglects the dynamic and changing role of the colonial state in STM for nearly half of the twentieth century.

Yet the story of STM in India must go beyond describing its relationship with colonialism and highlighting its circumscribed and dependent nature. It must address other questions as well: how did everyday practitioners (European and Indian) of science and technology engage with the opportunities that existed within a system that was not entirely autonomous? For the period 1900-47, we may express these questions as follows: How did the nature of STM in India affect the working lives—as distinct from intellectual debates—of its practitioners? How were their careers related to the political and economic changes occurring in interwar India?

The present thesis addresses such questions as they apply to an important category of STM practitioners—engineers in the public works, railways, military and private industry. It examines how changes in the engineering profession in India in the period 1900-47 were caused by and contributed to two important contemporary transformations in Indian society. The first of these was industrialisation, or the growth of private, especially large-scale, industry in the interwar years. The second was Indianisation, a term that refers simultaneously to the increasing proportion of 'native' Indians in government services and private firms, and to the political ideal this process embodied, as one of the central demands that nationalist leaders made of the colonial government.

As the first full-length history of engineers in India in this period, this thesis contributes in two ways to addressing the historiographical imbalance described above. First, it foregrounds the role of one of the most significant groups of practitioners, engineers. Second, it supplements the existing picture of nationalist discourse in the twentieth century with a study of the changing nature of the colonial state and the interventions of professionals and administrators (both Indian and European) in addition to politicians and intellectuals.

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[2] To quote Daniel R. Headrick's phrase. See his 'The Tools of Imperialism: Technology and the Expansion of European Colonial Empires in the Nineteenth Century', *Journal of Modern History*, Vol. 51, No. 2 (June, 1979), pp. 231-263.

[3] For convenience, I follow in this thesis the convention of referring to the two major races represented in British/colonial India by the terms 'Indian' and 'European'. Likewise, I use the term 'race' as a short-hand for the racial label applied to an individual for administrative purposes during the colonial period.

Reconstructing engineers' working lives using government reports, institutional and industrial archives, trade journals, and engineers' memoirs, the thesis presents the following arguments. First, the engineering profession in India expanded (in terms of the number of engineers) and diversified in the period 1900-47.[4] In particular, the interwar growth of private industry was reflected in increased opportunities for industrial engineers, whereas public works and railway engineers had been predominant before World War I. Second, the proportion of 'native' Indians among engineers in India grew considerably in this period, although Indianisation was not uniform across the profession. In private industry, on the one hand, technical training in-house and in foreign countries (usually the USA or Germany rather than Britain) enabled Indians to limit the influence of the colonial state and its machinery. On the other hand, British engineers and policymakers actively (though with limited success) resisted Indianisation in government services such as the public works and railways. Third, this resistance to Indianisation in government services illustrates contemporary ideas on race and technical expertise: Indian engineers were deemed to be lacking in qualities like courage, integrity and loyalty—which were considered essential for a government engineer—rather than in technical ability. Fourth, the experience of technical practitioners in our period was more complex than the existing historiography, with its emphasis on scientist-intellectuals and the discourse on modernity and nation, would suggest. By studying both British and Indian practitioners in parallel and in relation to each other—an approach that has rarely been adopted before[5]—I show that British engineers, despite Indianisation, continued to play an important role, especially in defining the culture of the engineering services; and that the Indian engineers who rose to prominence were not necessarily political radicals or participants in the extensive debates on science and modernity.

[4] Later in this chapter I discuss the sense in which I use the term 'profession' in this thesis.

[5] Pratik Chakrabarti, in his *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (Delhi: Permanent Black, 2004), argues for the advantage of studying the connections between 'the practice of science by Europeans and by Indians' (p. 24). While his book studies both European and Indian practitioners of science, it is the Indians who take centre stage in the latter chapters covering the twentieth century. Studies in which engineers play an important part tend (as a result of the periods they study and/or the questions they explore) to be confined either to British or Indian engineers. The former feature prominently in David Gilmartin, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', *The Journal of Asian Studies*, Vol. 53, No. 4 (November, 1994), pp. 1127-49; two Indian engineers are the protagonists in Daniel Klingensmith's analysis of 'nationalist engineering' in late-colonial and Independent India—see Chapter 5 of his *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007). For a rare exception, see Y. Srinivasa Rao, 'Electrification of Madras Presidency, 1900-1947' (PhD thesis, Indian Institute of Technology Madras, 2007). One of Rao's arguments is that British and foreign-trained Indian engineers tended to see electricity as ideal for large-scale industrialisation, while locally trained Indian engineers believed in electrification of the rural areas with a view to promoting agriculture, cottage industries and self-sufficient villages.

Finally, the thesis shows, through its detailed study of the dynamics of the Indianisation process, that the experience of engineers in interwar India cannot adequately be understood without taking into account the heterogeneous nature of the colonial state in interwar India. The interwar India in which both British and Indian engineers operated cannot be captured solely by notions of colonialism or nationalism, but needs to be understood also in terms of the continuously negotiated and redefined conception of a self-governing dominion within the British Empire, a conception that had currency for much of this period.[6]

In the following sections I develop further my critique of the existing historiography, explore a small number of works that have suggested alternative emphases and approaches, and finally explain the approach I have adopted in undertaking this study of engineers in India.

The Science and Empire literature: combating diffusionism

As noted above, the fundamental questions in the literature on the history of STM in India surround the relationship between science and colonialism. These works are positioned first as contributions to the history of 'Science and Empire',[7] and only then to Indian history. The object of investigation is something called 'imperial science', and what happens to it as it moves from the imperial metropolis to the far-flung corners of the empire.[8] Thus the research agenda for the Indian HSTM literature generally takes the form of the question: 'What does the Indian experience tell us about science and empire?'

Arguably the most important theme in this Science and Empire literature is the question of *diffusionism*. The idea that Western science was an unchanging entity that 'diffused' from the West (core/centre/metropolis) to the colonial world (periphery), which simply absorbed it, was cast in 1967 by George Basalla into a three-phase model that has since been discussed and criticised extensively. The 'spread of Western science', according to Basalla, occurred as

[6] See R.J. Moore, 'The Problem of Freedom with Unity: London's India Policy, 1917-47', in D.A. Low (ed.), *Congress and the Raj: Facets of the Indian Struggle 1917-47* (2nd edition, New Delhi: Oxford University Press, 2004), pp. 375-403, for a discussion of the dominion idea.

[7] The phrase 'Science and Empire' occurs in the title of Deepak Kumar (ed.), *Science and Empire: Essays in Indian Context (1700-1947)* (Delhi: Anamika Prakashan, 1991). See also the title of the special issue of *Osiris* edited by Roy MacLeod: 'Nature and Empire: Science and the Colonial Enterprise', *Osiris*, 2nd Series, Vol. 15 (2000). Here I use the term 'Science and Empire' as a shorthand for the wider body of works that is concerned with the relationship between science and colonialism across geographical locations.

[8] See Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (Basingstoke and New York: Palgrave Macmillan, 2007), p. 4. Raj further makes the point that the empires under consideration in this literature are almost always those of Western Europe. See *Ibid*., footnote 6.

follows. First the 'nonscientific' receiving society acted as 'a source for European science' where scientifically-minded observers explored the land and collected specimens for the various field sciences (Phase 1). It then entered a period of 'colonial science', when Europeans or 'native' scientists broadened the scope of their activity, while remaining dependent on metropolitan scientific traditions (Phase 2). Finally, it could potentially mature into the home of an 'independent' culture of science, provided a number of conditions were fulfilled (Phase 3).[9]

Basalla's model was a creature of its time, reflecting the contemporary influence of modernisation theory and the development discourse that went with it.[10] By Basalla's own admission, the model was 'preliminary … a heuristic device' intended to kick-start further study—an objective it more than fulfilled.[11] It appeared to have explanatory power in a number of cases, and enjoyed a certain measure of initial popularity.[12] Criticism, when it began, was not radical. Roy MacLeod contended, among other things, that the Basalla model was too general, did not account for 'intercolonial movement', and steered clear of describing the 'political and economic dynamics within a "colony"'.[13] He proposed instead a more complex, five-phase model that took such factors into account.[14] The diffusionist nature of the Basalla model, then, did not form the basis of this critique. Similarly, Ian Inkster questioned the universality of the Basalla model. Testing the model against the historical experience of Australia, Inkster argued that the moving of the 'focus' of scientific endeavour from Victoria to New South Wales in the 1870s/80s, resulting from the gold rush and associated demographic changes, illustrated the fact that a colony's experience depended on particular socio-economic factors working within it.[15] Nevertheless, the idea of diffusion continued to play a part in other studies in the 1980s. A prominent example is Daniel Headrick's *Tentacles of Progress*. Studying the 'transfer' of technologies (mining, railways, irrigation) from Europe to its colonies, Headrick argues that '[b]eyond [a] point' colonial governments 'withheld the culture of technology' from their

[9] George Basalla, 'The Spread of Western Science', *Science*, New Series, Vol. 156, No. 3775 (5 May 1967), pp. 611-22.
[10] David Wade Chambers and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge' in Roy MacLeod (ed.), 'Nature and Empire: Science and the Colonial Enterprise', *Osiris*, 2nd Series, Vol. 15 (2000), pp. 221-240, here p. 226. See also Roy MacLeod, 'Introduction' in the same volume (pp. 1-13), especially pp. 2-3.
[11] Basalla, 'The Spread of Western Science', p. 611.
[12] Chambers and Gillespie, 'Locality in the History of Science'.
[13] Roy MacLeod, 'On Visiting the "Moving Metropolis": Reflections on the Architecture of Imperial Science' in Nathan Reingold and Marc Rothenberg (eds.), *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, D.C. and London: Smithsonian Institution Press, 1987), pp. 217-249, here p. 226.
[14] Roy MacLeod, 'On Visiting the "Moving Metropolis"', pp. 229-230, including Table 1.
[15] Ian Inkster, 'Scientific Enterprise and the Colonial "Model": Observations on Australian Experience in Historical Context', *Social Studies of Science*, Vol. 15, No. 4 (November 1985), pp. 677-704; see especially pp. 697-698.

subject populations—a culture that he implicitly assumes must diffuse from Europe to the colonies.[16]

Thus the early Basalla-inspired studies granted limited, if any, agency to the colonies themselves in the 'spread of Western science.'[17] But the issue was not just one of active or passive appropriation. It was a question also of *what* was diffusing: was there really a monolithic, unchanging entity called 'modern' or 'Western' science that could simply be carried over to the colonies? Further, did this diffusion imply that there existed no science in the colonies before? And finally, if agency be attributed to colonial subjects, to whom or to what tradition did science in the colonies belong—was it 'Western', 'colonial', 'indigenous', or something else?

Questions such as these began to be raised in the literature from the 1990s onwards, as the initial misgivings about the Basalla model turned into a full-blown critique of most of its assumptions and implications. One of the first major panoramic works to appear on science in colonial India, Deepak Kumar's *Science and the Raj* (1995), tackled the idea of an unproblematic, impersonal diffusion by highlighting the 'response and resistance' of colonial subjects to the introduction of Western science, including revivalist attempts to find analogues to modern scientific thinking in local traditions.[18] Later works took on diffusionism more directly. Contesting the idea of a simple transplantation of Western science in India, Gyan Prakash argued that it had to be 'translated' for the colony, 'staged' in a way that utilised elements of wonderment and performance that undermined the purported unemotional, objective nature of science.[19] David Arnold's wide-ranging, synthetic work on STM in colonial India emphasised that '[a] recognition of the relative openness and adaptability of India's pre-colonial scientific and technological tradition supports the view that an interactive model might be more appropriate for the colonial period rather than one that depicts either outright confrontation between two intransigent forces or an automatic unassailable Western

[16] See Daniel Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York and Oxford: Oxford University Press, 1988). The quote is from p. 345.

[17] It has been pointed out that in other contexts, the term 'diffusion' has been used without denying agency to the receiving party. Tirthankar Roy writes that 'diffusion processes', as seen from the economic historian's viewpoint, 'are far from passive, and depend on how users perceive benefits and costs associated with the adoption of a new idea, and how they can make a foreign idea work in their own milieu.' T. Roy, Review of Kapil Raj's *Relocating Modern Science*, in *Journal of Global History*, Vol. 3, Issue 01 (March 2008), pp. 129-131, here p. 130.

[18] Deepak Kumar, *Science and the Raj, 1857-1905* (Bombay and Oxford: Oxford University Press, 1995), Chapter 6: 'Response and Resistance'. Kumar did not wish to offer an alternative model to Basalla's: 'Models, though currently in fashion, are of limited value for such a complex scenario.' *Ibid*., p. 18.

[19] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton: Princeton University Press, 1999), esp. Chapter 2.

ascendancy.'[20] S. Irfan Habib and Dhruv Raina wrote in 2007 that recent scholarship had found that 'the standard tale of the assimilation of modern science as a Western cultural import was inadequate and missed out the multifarious nature of exchange between modern science and so-called traditional knowledge forms.'[21]

Thus it would not be an exaggeration to say that the single common motivation underlying much of the recent literature has been to deal with the problem of diffusionism.[22] Shruti Kapila makes a similar point in a recent paper: 'One of the main emphases of the more recent imperial histories of science has been to critique and overthrow George Basalla's tripartite model of the "diffusion" of science from the West (or the core) to the East (or the periphery).' She mentions briefly some ways in which the literature attempts to do this (emphasising the concepts of 'contact zones' and 'circulation' of knowledge; treating science as a source of colonial power).[23] Similarly, I argue below that the literature's strategies to combat diffusion can be understood under three different headings (which are commensurable with the strategies mentioned by Kapila). These strategies are used in an overlapping manner, and often a single work uses more than one of them. In the following passages I analyse these strategies in detail, and draw attention to some of the problems inherent in them.

Colonial science, subordination, and hybridity

The literature challenges the idea of an unchanging/location-independent Western science by developing the concept of 'colonial science', a science whose characteristics would reflect the specificities of the colonial relationship. They use it in a sense different from the Basalla model, whose second phase was also called 'colonial science', and indicated a situation where the scientific community in the colony is still dependent on the metropolis for research directions, professional evaluation and training for its practitioners. Basalla's critics are in agreement with the idea that science in colonial India lacked autonomy in important ways—indeed, for them, the 'colonial' aspect of science in India in this period is perhaps its most important feature. However, they have sought to ground the term in the specifics of the colonial locality, including political and socio-cultural factors (as opposed to Basalla's usage, which did not emphasise

[20] Arnold, *Science, Technology and Medicine in Colonial India*, p. 9.
[21] S. Irfan Habib and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007), 'Introduction', p. xxiii.
[22] Almost every major work in the Science and Empire literature discussed here begins by discussing and pointing out the shortcomings of the Basalla model, the prominent exceptions being Gyan Prakash, *Another Reason,* and Mark Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine 1859-1914* (Cambridge, New York and Melbourne: Cambridge University Press, 1994).
[23] Shruti Kapila, 'The Enchantment of Science in India', *Isis*, Vol. 101, No. 1 (March 2010), pp. 120-132, here pp. 122-3.

struggle, could apply to different types of colonies, and did not take into account the significance of the racial identity of the practitioners of 'colonial science').[24]

Such local dynamics and struggles are an important theme in many later works. At the core of Deepak Kumar's *Science and the Raj* is a description of the scientific bureaucracy, survey organisations, and the administrative and economic imperatives of colonial scientific research. Significantly, Kumar foregrounds the constant negotiation that was at the heart of this process—colonial officials at various levels in the bureaucracy had their own ideas about the administration of science, although they were frequently frustrated by the rigid hierarchies of colonial India.[25] The frustrations and lack of autonomy of science in colonial India is also a recurring theme in Pratik Chakrabarti's *Western Science in Modern India*. He stresses the marginal, provincial nature of colonial science—as in his studies of the Asiatic Society of Bengal, where European scientists found themselves 'in a tragic quest for a centre in the periphery',[26] and of Thomas Holland's vision for mineral-based industry, which was not realised because as a colonial, he was in a position of dependence.[27] Similarly, several essays in Roy MacLeod and Deepak Kumar's edited volume on *Technology and the Raj* are studies of the limited scope of the science and technology (S&T) project in India, which was always subject to the needs of the colonial government.[28]

By emphasising the importance of 'locality', the concept of 'colonial science' also serves another purpose: it adds complexity to the notion of a direct transplantation of Western science in the colony. Scholars of science and empire have asserted that colonial locations, with their distinctive features and relationships of power with the metropolis, are fruitful for social constructivist analyses of the nature of science.[29] Thus Chakrabarti sees the concept of colonial science as illustrating that science is a 'social epistemology'.[30] Zaheer Baber writes of the 'colonial construction of modern science', arguing that administrative imperatives in colonial India contributed to the canon of 'Western' science, as in the case of James Rennell's map-

[24] Arnold, *Science, Technology and Medicine in Colonial India*, pp. 9-15.
[25] Kumar, *Science and the Raj*.
[26] Pratik Chakrabarti, *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (Delhi: Permanent Black, 2004), p. 94.
[27] *Ibid.*, p. 145
[28] Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995). See for example the essays by Arun Kumar (pp. 216-232) and V.V. Krishna (pp. 289-323).
[29] As Chambers and Gillespie put it: 'constructivist approaches, because they emphasize the locally contingent character of the knowledge-making process, held particular promise and powerful analytic consequence for the emerging discipline of colonial science history.' Chambers and Gillespie, 'Locality in the History of Science', pp. 221-2.
[30] Chakrabarti, *Western Science in Modern India*, p. 17.

making.[31] What all of these positions have in common is the notion that the science that operated in colonial India was particular to its locality in some way. Yet they make slightly different arguments about the nature of 'colonial science', and it is important to tease out these differences.

The first of these arguments (for instance, Baber's position above) is that the enterprise of colonialism and the particular administrative and economic needs of government in the colonies shaped the work done by colonial-official scientists, and fed back into the mainstream of science as seen in the metropolis. This argument is important because it shows that what is viewed as Western science was often constructed in the colony. However, it does not tell us much about the process by which this knowledge was constructed. If there was no cognitive input from local sources, or no use of locally prevalent techniques, such a colonial science could still reasonably be viewed as Western, after the methodology and theoretical framework used. Such arguments, moreover, are usually made about the early years of colonialism, and usually refer to the work of European scientists in the colony.

The second position (adopted most widely in the literature) does not stress co-production, but sees 'Western' science as being reinterpreted in and for the colony (usually by Indian thinkers and popularisers of science). Chakrabarti sets out to ask 'how...a journey from centre to periphery influenced the constitution of science, and what the [sic] new meanings science received from the centre may have had in the periphery. How did the periphery view the centre? Did it submit entirely to its terms, or did it attempt to subvert and resist it?'[32] There is a departure here from Basalla in the emphasis on subversion and resistance; however, the science of the centre is essentialised, taken as flowing to the periphery, whose participation in the constitution of 'colonial science' is solely one of reaction. Similarly, Prakash argues that Indian elites, in translating Western scientific ideas into vernacular languages, engaged in a 'renegotiation of knowledge and power', setting themselves up as the champions of an Indian modernity. He views this as a form of 'hybridity', although he explicitly distances himself from the 'celebration of hybridity as cultural syncretism, mixture, and pluralism.' Instead, '[h]ybridity...refers to the undoing of dominance that is entailed in dominance's very establishment'[33]—an argument which appears to suggest that the main difference between science in the colony and the metropolis lay in who presented it to the layperson, and how.

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[31] Zaheer Baber, 'Colonizing nature: scientific knowledge, colonial power and the incorporation of India into the modern world-system', *British Journal of Sociology*, Vol. 52, Issue 1 (March 2001), pp. 37–58. The quoted phrase is from p. 40.
[32] Chakrabarti, *Western Science in Modern India*, pp. 16-17.
[33] Prakash, *Another Reason*, pp. 83-4.

The third view of 'colonial science' is directly opposed to this position: in fact 'syncretism' is central to it. For example, Ian Derbyshire shows that the construction of the Indian railways was not a case of the transfer of Western technology in an 'undiluted' form: instead, 'a new, syncretic "Indian approach" to railroad building emerged, an approach that married traditional Indian and modern Western practices', and was used in varying degrees in way-levelling, plate-laying, tunnelling and the building of bridges.[34] Other instances of this kind include the agricultural scientist Albert Howard's incorporation of local techniques,[35] and the irrigation engineer Arthur Cotton's damming of the Godavari in southern India using the existing pre-colonial *anicut* technology of encased rubble rather than masonry.[36] But perhaps the clearest and most sustained adoption of such a position is to be found in the recent work of Kapil Raj.[37] In *Relocating Modern Science,* Raj rejects the usual terminology related to colonialism and talks instead of a 'contact zone'. He presents several case studies, including a late-seventeenth-/early-eighteenth-century botanical treatise developed along the lines of European treatises by a Frenchman working in India in collaboration with local informants and artists; and the creation of a legal text, Jagannatha's *Vivadabhangarnava*, 'constructed through a negotiation between legal experts belonging to two distinct cultures' and 'used by court pundits and British judges alike'.[38] While he is careful to point out that hierarchies and power relationships existed, 'South Asia was an active, although unequal, participant in an emerging world order of knowledge...the contact zone was a site for the production of certified knowledges which would not have come into being but for the intercultural encounter between South Asian and European intellectual and material practices that took place here.'[39] Central here is the notion of the 'circulation' of knowledge: 'localities constantly reinvent themselves through grounding (that is, appropriating and reconfiguring) objects, skills, ideas and practices that circulate both within narrow regional or transcontinental—and indeed global—spaces.'[40]

[34] Ian Derbyshire, 'The Building of India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920' in MacLeod and Kumar (eds.), *Technology and the Raj*, pp. 177-215, here p. 202.
[35] Mark Harrison, 'Science and the British Empire', *Isis*, 96 (2005), pp. 56-63, here p. 61.
[36] Arnold, *Science, Technology and Medicine in Colonial India*, p. 117.
[37] Raj's work (see below) is also cited by Shruti Kapila as an example of the (anti-diffusionist) 'circulation' approach. Kapila, 'Enchantment', p. 122.
[38] Raj, *Relocating Modern Science*, pp. 134-5.
[39] *Ibid.*, p. 13.
[40] *Ibid.*, p. 21.

Indigenous knowledge, response, and race

The crudest form of diffusion that imagines the recipient of the diffusing knowledge to be completely 'nonscientific' is countered in the literature by drawing attention to 'the multifarious nature of exchange between modern science and so-called traditional knowledge forms.'[41] But how exactly the elements of 'indigenous' or 'traditional knowledge forms' interacted with that of the science taught in colonial institutions is seldom addressed. We know that until the early nineteenth century, in the years prior to Macaulay's famous Minute and Wood's Dispatch on education, the British colonial administration was positively disposed, or at least neutral, to the system of traditional schools that existed across its Indian possessions.[42] But we know very little about the system of teaching employed at these schools, the syllabi operating within them, and the application or otherwise of this learning in the technologies of pre-colonial India.

Thus the term 'indigenous' is frequently used to refer to a body of knowledge that existed in the past, and has since *ceased to evolve*.[43] In the place of a discussion of the interaction (or otherwise) of the colonisers' science with 'indigenous' knowledge systems and practices as they existed *at the moment of the first colonial encounter*, what we mostly have in the literature is a detailed description of the revivalist reinterpretation of ancient Indian systems of knowledge. This refers to the discursive musings of Indian elites, who, faced with the brand of science sponsored by the colonial administration, bought into its claims to modernity and objectivity, and proceeded to investigate Indian scriptures and ancient history to identify elements that seemed to anticipate or agree with this 'modern' science. Thus Habib and Raina point out the cases of Ramchandra, a mathematician who attempted to derive the differential calculus from the traditional *Bija-Ganita* of Bhaskaracharya,[44] and Raja Rammohan Roy, the Bengali reformer, who 'translated the Sankaritic Vedanta into the language of Cartesian rational theism'.[45] Almost every writer on science in nineteenth-/early-twentieth-century India refers to

[41] S. Irfan Habib and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007), 'Introduction', p. xxiii.
[42] Zaheer Baber, 'Science, Technology and Colonial Power' in *Ibid.*, pp. 102-158.
[43] See, in a related but not identical context, Meera Nanda, 'The Epistemic Charity of the Social Constructivist Critics of Science and Why the Third World Should Refuse the Offer' in Noretta Koertge (ed.), *A House Built on Sand: Exposing Postmodernist Myths About Science* (New York and Oxford: Oxford University Press, 1998), pp. 286-311. Nanda argues that well-meaning constructivist theories of science undermine the possibility of social and political change in non-Western societies by implying that the only valid form of knowledge for them is that of their (pre-colonial) ancestors, denying them the option of choosing well-established aspects of 'modern' science to critique injustices in their societies.
[44] S. Irfan Habib and Dhruv Raina, 'Copernicus, Columbus, Colonialism, and the Role of Science in Nineteenth-century India', in idem. (eds.), *Social History*, pp. 229-251, here p. 243.
[45] *Ibid.*, p. 238.

the Edinburgh-trained Bengali chemist P.C. Ray, who wrote a history of Hindu chemistry and found that experiment and observation underpinned the *Rasendra Chintamani* and the *Rasaprakasha-sudhakara*, Hindu texts dating from around the fourteenth century.[46] The search for the rational in ancient Hindu culture as undertaken by Ray and Swami Dayananda, among others, is dealt with extensively by Gyan Prakash.[47] But these are not studies of the practice of science being influenced by pre-colonial ways of thinking: instead, they show, through discourse analysis, how the elites among the colonial subjects attempted to make sense of the claims of 'modern'/'Western' science. (One of the few examples in the literature actually to make the link between a traditional cosmology and the practice of science is that of the physicist Jagadish Chandra Bose, who, after having gained recognition in metropolitan scientific circles for his research on electromagnetic waves, proceeded to build an instrument to measure the responses of plants to various stimuli. Bose's stated inspiration for his work on plant physiology was an Indian conception of the unity of life in the plant and animal kingdoms.[48])

But 'traditional knowledge forms' (which asserted their difference from official 'colonial science') were more than an intellectual pool of ideas for elites to dip into in their discourse. At least in some instances, they continued to be actively pursued through the colonial period, indeed well into the twentieth century—the best example being the case of medicine (especially the Ayurvedic and Unani systems). David Arnold argues that the colonial medical establishment began with an Orientalist engagement with the texts of these 'indigenous' systems of medicine, and with a selective appropriation of Indian *materia medica*. Although its rhetoric grew progressively more authoritative, Arnold suggests that Western medicine's aims to displace 'indigenous' medicine, at least in the nineteenth century, were never close to being fulfilled.[49] Elsewhere, Arnold points to the continued development of 'indigenous' medicine parallel to state-sponsored learning, as in the case of a movement to teach 'indigenous' systems of medicine alongside the Western one (a School of Indian Medicine was set up in Madras Presidency as late as 1924).[50] Viewing 'indigenous' systems of medicine through the eyes of the practitioners themselves (as opposed to those of the colonial state), Kavita Sivaramakrishnan has depicted a rich and active culture of Ayurvedic medicine in

[46] *Ibid.*, p. 246; see for example Chakrabarti's *Western Science in Modern India,* Chapter 7; Prakash, *Another Reason,* Chapter 4 ; Arnold, *Science, Technology and Medicine in Colonial India*, Chapters 5 and 6.
[47] Prakash, *Another Reason,* Chapter 4.
[48] *Ibid.* and Subrata Dasgupta, 'Response to Western Science: Failures and Successes' in Habib and Raina (eds.), *Social History*, pp. 326-51.
[49] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley, Los Angeles and London: University of California Press, 1993), Chapter 1.
[50] Arnold, *Science, Technology and Medicine in Colonial India*, Chapter 6.

twentieth-century Punjab. Not only were practitioners engaged in positioning their medicine against the claims of Western medicine, she argues, they were also engaged in a lively internal debate about the ethno-religious basis of Ayurveda: representations of Ayurveda as a Hindu science with a Hindi vocabulary were challenged by Sikh practitioners, who sought to ground it in a more local tradition through the medium of Punjabi.[51]

The different trajectories of 'indigenous' or 'traditional' learning as portrayed with respect to the physical sciences and medicine leads us to ask the question: what exactly is meant by 'indigenous' and 'Western' science?[52] The examples discussed above suggest a lack of clarity in the usage of these terms. From the point of view of the physical sciences, 'indigenous' or 'traditional' knowledge forms appear to refer in the literature to ancient Indian (mostly Hindu) texts, used by Indian elites in their project of revivalism. In the case of medicine, however, it clearly refers to live systems of practice that survived into the colonial era. Here 'indigenous' clearly means that which already existed in India prior to its incorporation into the British Empire. Thus Ayurveda was 'indigenous' not in the sense of being a purely subcontinental construction (it interacted with other systems and sourced ingredients from across the world),[53] but in terms of pre-dating the colonial era. It was also 'indigenous' in another sense: it was that which was *not* the official medicine of the colonial government. This draws attention to the label 'Western' medicine. Although there were (limited) borrowings from and interactions with local practices and knowledge, this medicine remained recognisable as 'Western' primarily because of its association with the colonial state apparatus. Indeed it may be argued for discussions of STM in general that 'Western' often means 'official' or 'that of the state' while 'indigenous' means 'pre-colonial in origin' and 'unofficial'. This is problematic, for 'colonial science' was indigenous (in the sense of being local) to India in the colonial period; and the reference to STM of the state simply as 'Western' negates to some extent the emphasis on the socially constructed and particularly local character of 'colonial science.'

For this reason, the notion of Indian 'response' to Western science also becomes problematic. While it might be reasonable to talk of the 'response' of colonial subjects to a new institutional system of knowledge in the first flush of the colonial encounter, the idea loses some

[51] Kavita Sivaramakrishnan, 'The Languages of Science, the Vocabulary of Politics: Challenges to Medical Revival in Punjab' in *Social History of Medicine*, Vol. 21, No. 3 (2008), pp. 521–539.
[52] David Arnold, writing specifically on medicine, draws attention to the complex 'relationship between what for convenience we call "indigenous" and "Western" medicine (as if they were totally independent and internally homogeneous systems of thought and practice)', and argues that it 'needs to be looked at in more pluralistic and dialectical terms, terms that allow for a continuing interaction between the two during the long history of colonial rule in India …' Arnold, *Colonizing the Body*, p. 13 and p. 14.
[53] See Arnold, *Science, Technology and Medicine in Colonial India*, p. 71.

of its meaning a hundred or more years into colonial rule, when the responder is often contributing to the science (now a colonial hybrid) he is taken to be responding to. Thus to talk of Jagadish Chandra Bose's '[r]esponse' to Western science when he operated within the colonial administration's scientific service is, terminology-wise, not very helpful.[54] Also noteworthy in this regard is the fact that when European scientists in the colony are discussed, they may be seen as scientists of the periphery, as dependent and frustrated, but they are not seen as 'responding' to Western science.[55] Indians, by contrast, regardless of their educational background, are assumed to belong to a different tradition, one to which 'Western' science is external.

This leads us to examine the role of race, which plays an important part in the understanding of 'colonial science' (and more so in the history of India than of settler colonies like Australia or Canada). Ideas associating certain races with scientific and technical ineptitude abounded in the nineteenth and twentieth centuries. Black Americans were considered inherently less inventive than their white compatriots, were not allowed to fly military aircraft in the interwar period, and were not employed as telephone operators at Bell until after World War 2. Significantly for colonial S&T, when 'Western' technologies were 'transferred' to other, usually colonial, locations, Europeans went along to operate them, as in the case of British and French pilots on the ships sailing through the Suez Canal. As of 1917-18, all railway officers in the Dutch East Indies were Europeans.[56] A few scholars have studied similar ideas operating in colonial India. Daniel Headrick shows that prevailing views of Indians as lacking in technical aptitude were related to the European domination of the upper railway ranks in pre-Great-War India and the general reluctance of the colonial government to set up technical education facilities for Indians.[57] The link between such attitudes and the system of technical education is also explored by Aparna Basu. Many of the witnesses called by the Slacke Committee (1912), set up to provide advice on the proposal for a technical institution in Calcutta, 'held that Bengalis as a race were unfit for practical work. It was because they lacked interest and stamina

[54] Dasgupta, 'Response to Western Science: Failures and Successes'.
[55] An exception is Mark Harrison's argument that 'the IMS [Indian Medical Service] was slow to respond to, and actively resisted, medical trends emanating from the metropole' (Harrison, *Public Health in British India*, p. 35). However, this is more a question of specific measures within a commonly accepted framework of science/medicine than of resistance to them because they belonged to a different ('Western') system.
[56] David Edgerton, *The Shock of the Old: Technology and Global History since 1900* (London: Profile, 2008 [2006]), pp. 131-6.
[57] Headrick, *Tentacles of Progress*, Chapter 9.

that they could not find employment.'[58] This characterisation of Bengalis had a long lineage, shaped, as David Arnold argues, by the region's frequent experience of malaria, which was taken to have made Bengalis weak and unmanly.[59] Deepak Kumar has demonstrated that racial prejudice (in varying degrees) played a large part in the reluctance of the government's scientific and medical officers to allow Indians responsible positions in their organisations in the nineteenth century.[60] Arnold has shown that this continued to be the case in the twentieth century. The colonial government's scientific services were predominantly European in composition until at least 1920: the Indian mind was deemed to be lacking in the qualities required to conduct scientific research.[61]

While many of these accounts deal with the long nineteenth century, this thesis examines the issue of race with a particular emphasis on interwar India. Prejudices about Indians continued in this period, but took on a slightly different character in relation to engineers, as I will discuss in Chapters 4 and 5.

Science, modernity and nationalism

The anti-diffusionist approaches discussed so far are contained in varying degrees in works focusing on the notion of 'modernity'—one of the most important themes of the literature.[62] Indeed David Arnold suggests that understanding the significance of 'science as modernity' is the best available alternative to diffusionism,[63] in view of 'the authority of science, technology and medicine as central attributes of India's modernity, drawing upon indigenous as well as Western sources and finding contested expression in both imperial ideology and nationalist agendas.'[64] Thus a need to construct a particularly Indian modernity has been seen as the driving

[58] Aparna Basu, 'Technical Education in India, 1854-1921', in Aparna Basu, *Essays in the History of Indian Education* (New Delhi: Concept, 1982), pp. 39-59, here p. 51. On the Slacke Committee, see also *ibid.*, p. 48 and endnote 44 on p. 58.
[59] Arnold refers to both European and Bengali perceptions of Bengali racial identity. David Arnold, '"An ancient race outworn": Malaria and race in colonial India, 1860-1930' in Waltraud Ernst and Bernard Harris (eds.), *Race, Science and Medicine, 1700-1960* (London and New York: Routledge, 1999), pp. 123-143.
[60] Deepak Kumar, 'Racial Discrimination and Science in Nineteenth Century India', *Indian Economic and Social History Review*, 19 (1982), pp. 63-82.
[61] Arnold, *Science, Technology and Medicine in Colonial India*, Chapter 5.
[62] The centrality of 'modernity' is evident in the titles of books on science in colonial India: for instance, *Another Reason: Science and the Imagination of Modern India* (Prakash); *Western Science in Modern India* (Chakrabarti); *Relocating Modern Science* (Raj); and Dhruv Raina, *Images and Contexts: The Historiography of Science and Modernity in India* (Delhi and Oxford: Oxford University Press, 2003).
[63] Arnold, *Science, Technology and Medicine in Colonial India*, p. 15.
[64] *Ibid.*, p. 2.

force behind colonial subjects' participation in debates on science. Three observations are in order here. First, the discussions on modernity are largely discussions of 'native' Indians' pronouncements on science. Second, the need to construct an Indian modernity is seen to have arisen in 'response' to the perceived modernity of the science brought by the colonial power. This 'response' occurred primarily through a strategy of revivalism, a search for elements of modernity in India's ancient past and its 'indigenous' systems of learning (discussed at length above). Third, ideas of modernity are viewed as an integral component of the Indian nationalist movement that arose in the late nineteenth century and came into its own in the twentieth. Partha Chatterjee famously argued that Indian nationalism tried to address its 'problematic'—the aim of showing the colonial subject to be autonomous and possessing agency to shape his or her own history—using a 'thematic' (a framework of ideas) that was itself based on Western post-Enlightenment rationalism. In the process it had to create a discourse that was 'different' from that of the coloniser, but which nevertheless shared its emphasis on 'modernity'.[65] As a corollary, S&T, closely associated with ideas of modernity, became central to the discourse of nationalism.

It is this third point that forms the focus of the literature on S&T in twentieth-century India**.** Gyan Prakash argues that the British government's policies on technology and industrialisation can be described using the Heideggerian concept of a 'standing-reserve' comprising (here) Indian resources, human and natural, which would be acted upon by 'technologies of government'. The emerging nationalist discourse of the twentieth century, he argues, appropriated this idea of a 'standing-reserve'; their critique of the colonial regime was simply that it did not go far enough in its utilisation of India's resources through industrialisation, and that an independent state would be better placed to do so. Furthermore, 'technologies of government' *were* the modern state: the state was conceptualised and configured within the boundaries of the action of these technologies.[66] While undoubtedly useful in understanding the emerging ideologies that would find a place in Independent India, this focus on nationalism's use of notions of modernity results in a slightly skewed picture, one in which the colonial government, having appeared to provide the template for the modern nation-state that the nationalists would appropriate, recedes to the background in the twentieth century.

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[65] Partha Chatterjee, 'Transferring a Political Theory: Early Nationalist Thought in India', *Economic and Political Weekly*, Vol. 21, No. 3 (18 January 1986), pp. 120-128. See also David Arnold's discussion of 'modernity' and Indian nationalism on pp. 16-17 of his *Science, Technology and Medicine in Colonial India.*

[66] Prakash, *Another Reason*, Chapter 6.

In this respect, Deepak Kumar's account of the 'disunity in the science and technology for development discourse' leading up to Independence is more balanced.[67] It tells a story of Indian nationalist voices and the colonial government each articulating their own versions of what a modern India should look like. During World War II, some years after the Indian National Congress had first adopted scientific planning as an ideal, the colonial government began working out its own programme to improve the material basis of Indian life as 'a plausible answer to Gandhi's call to the British to "Quit India"'.[68] Pratik Chakrabarti points out that individual nationalist thinkers sometimes embodied contradictory ideas: the geologist P.N. Bose, who helped locate the mineral deposits that led to the Tatas' iron and steel factory, viewed industrialisation as, at best, a necessary evil; M.N. Saha, while a staunch socialist, looked up to America's model of industrialisation. These contradictions, he argues, were eventually resolved in the post-1930s Nehru era, when what triumphed was a 'dominant metropolitan industrial logic: a global consensus among politicians, scientists, and economists which presided over the emergence of the idea of a powerful state and simultaneously saw the rise of modern economics and the increasing application of science and technology to design that state.'[69] What is more, '[i]ndustrialism provided the ultimate confirmation of the acceptance and habitation of science in India.'[70]

As is apparent from the above, these studies of science and modernity are closely related to discussions of nationalism. Indeed they may be seen in the context of a wider literature on STM and national identity, as exemplified by recent special issues of the journals *History and Technology* ('The National Identities of Engineers', 2007) and *Osiris* ('National Identity: The Role of Science and Technology', 2009). The editors of both these issues address existing theories of nationalism, arguing that nations come into being not only through the creation of a mythical, shared past but also through the specification of a common, *modern* future, which will be achieved by means of science and technology.[71] The broad theme in the *History and Technology* issue is the manner in which engineers and administrators have shaped engineering education and professional identities in response to politically dominant concepts of

[67] Deepak Kumar, 'Reconstructing India: Disunity in the Science and Technology for Development Discourse, 1900-1947', *Osiris*, 2nd Series, Vol. 15 (2000), pp. 241-257.
[68] *Ibid*., p. 251.
[69] Chakrabarti, *Western Science in Modern India*, p. 296.
[70] *Ibid*., p. 297.
[71] Konstantinos Chatzis, 'Introduction: The National Identities of Engineers', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 193-6; Carol E. Harrison and Ann Johnson, 'Introduction: Science and National Identity', *Osiris*, Vol. 24, No. 1 (2009), pp. 1-14, here esp. p. 3.

the nation.[72] While most of these studies pay attention to the specifics of practitioners' training and modes of professional organisation, Carol Harrison and Ann Johnson (in the *Osiris* special issue) are conscious of the inherent danger in studies of modernity and nationhood of reducing S&T projects to content-less 'logo[s]', thereby '[overlooking] the literally dirty business of making technologies'.[73] This is indeed a difficult problem to surmount, as illustrated by Suzanne Moon's paper in the same issue, in which the Trikora/Krakatoa steel factory appears primarily as a site to study the discursive aspects of 'the postcolonial project of national identity formation in Indonesia', with little emphasis on the material content of the factory, its construction or operation.[74]

A similar problem applies in the works on India discussed above: the modernity approach often limits the scope of the narratives that adopt it. It serves its primary purpose, which is to trace debates on the role of S&T in the making of a modern nation-state. To do this, however, it relies heavily on the discourse of elite figures such as P.C. Ray, M.N. Saha and J.C. Bose (not to mention Nehru and Gandhi) who made their views widely known in print, writing in English (or Bengali).[75] These were undoubtedly extremely influential figures; but the history of STM in India must also be a history of practice and practitioners, which requires us to bring studies of 'doing' science and technology and 'being' scientists or technologists into the picture.

HSTM as Indian history: engineers in interwar India

David Edgerton has argued recently that histories of technology must not just be studies of technology (in which history provides the examples), but of 'technology *in history*—asking

[72] See for instance Yiannis Antoniou, Michalis Assimakopoulos and Konstantinos Chatzis, 'The National Identity of Inter-war Greek Engineers: Elitism, Rationalization, Technocracy, and Reactionary Modernism', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 241–261; Juan C. Lucena, 'De Criollos a Mexicanos: Engineers' Identity and the Construction of Mexico', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 275-288. For an early statement of the influence of social/ political 'codes of meaning' on engineers' identities, see Gary Lee Downey and Juan C. Lucena, 'Knowledge and Professional Identity in Engineering: Code-Switching and the Metrics of Progress', *History and Technology*, Vol. 20, No. 4 (December 2004), pp. 393–420.

[73] Carol Harrison and Ann Johnson, 'Introduction: Science and National Identity', p. 7.

[74] Suzanne Moon, 'Justice, Geography and Steel: Technology and National Identity in Indonesian Industrialization', *Osiris*, Vol. 24, No. 1 (2009), pp. 253-277. Some of the other papers in the same issue of *Osiris*, which are more directly linked to STM practitioners and institutions, are discussed later in this chapter.

[75] As a partial exception to this pattern we may cite some works on S&T in postcolonial India that have integrated detailed studies of actual events and practices with an approach that is centred on ideas of 'postcoloniality', closely linked to 'modernity': see Itty Abraham, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State* (London and New York: Zed, 1998); Akhil Gupta, *Postcolonial Developments: Agriculture in the Making of Modern India* (New Delhi and Oxford: Oxford University Press, 1999).

questions about the place of technology in wider historical processes.'[76] In the field as it stands, however, 'historical questions are often secondary', while the main object of study is something called 'the question of technology', which refers to 'the nature of technology and its relations to wider culture'.[77] Taking an uncritical view of history as providing the context for a particular technology obscures the fact that the very 'context' should be an object of analysis. Writing 'post-contextual' histories of technology, then, can advance our understanding of history itself.[78]

My approach in this thesis, as well as my earlier historiographical critique, is in keeping with these observations. The history of STM in the colonial world has long been concerned with what we might call the 'question of colonial science' (in analogy to 'the question of technology'). Although studies of the social construction of this colonial science stress the importance of location, its role is often merely to lend context to science, which remains the main explanandum. This is the crux of the problems inherent in the historiography of Science, Empire and Nation as highlighted in the previous section.

In this thesis I seek to overcome some of these problems by taking an approach that places the history of STM in India firmly within Indian history. I am concerned not only with 'colonial technology' or 'Indian engineering', but also with what we can learn, by studying an important group of practitioners, about the nature of the Indian economy, polity and society in the interwar period. The colonial state was not a homogeneous entity placed in direct opposition to nationalist politicians. Constitutional reform and the step-wise introduction of provincial autonomy gave elected Indian ministers a measure of executive power in the provinces from 1919; Indians were also able to join the central Legislative Assembly in large numbers, where they could act as a check on the executive, composed mainly of British officials.[79] Not only was the trajectory of the engineering profession shaped by the evolving colonial state and its economic policies; studying engineers in various sectors also illuminates the workings of the state in this transitional period of Indian history.

In adopting this approach, I aim to extend the fruits of a small number of HSTM works studying the interwar period, which illustrate how the changing colonial state and the institutional basis of STM were closely linked. David Arnold's *Science, Technology and*

[76] Edgerton, *The Shock of the Old*, p. 211. Emphasis mine.
[77] David Edgerton, 'Innovation, Technology or History: What Is the Historiography of Technology About?', *Technology and Culture*, Vol. 51, No. 3 (July 2010), pp. 680-697, here p. 691. Edgerton quotes Thomas Misa as using the phrase 'the question of technology', following Martin Heidegger.
[78] *Ibid*., pp. 694-6.
[79] See, for instance, Burton Stein, *A History of India*, 2nd edn, ed. David Arnold (Oxford: Wiley-Blackwell, 2010), Chapter 7 for an overview of the constitutional reforms in this period. The changing structure of government in our period is discussed in Chapter 2 below.

Medicine in Colonial India is exceptional in noting that '[a] history of science in India must also be a history of India, not merely a history of the projection of Western science onto India'[80]—an injunction it follows with considerable success. Arnold demonstrates the importance of the growing presence of Indians in the legislative machinery in the twentieth century. Agitations by Indian members of the provincial legislatures for the teaching of local systems of medicine led to the creation of a School of Indian Medicine in Madras Presidency in 1924; increasing provincial autonomy also created a tug-of-war between the proponents of centralised and decentralised scientific research, leading to a mix of all-India scientific services and central institutes on the one hand and provincial institutes/ university departments on the other.[81] A recent paper by Pratik Chakrabarti argues that the provincialisation of medical research and the Indianisation of the Indian Medical Service (IMS) in the interwar years prompted British medical officers increasingly to seek refuge in the idea of centralised institutes, of which they would retain control. Indian politicians and university professors thought differently, and successfully opposed a proposal to set up a Central Medical Research Institute in the hill station of Dehra Dun.[82] The sociologist Roger Jeffery's early work on the medical profession in India is important in this context. In two papers published in the late 1970s, Jeffery studied rivalries within and without the profession of 'allopathic' (i.e. 'Western', but not homoeopathic) doctors in twentieth-century India. Jeffery shows that the course of Indianisation of the medical profession in the interwar years, and the subsequent 'deprofessionalisation' of allopathic doctors in the decades after Independence, were closely tied to changes in the nature of the state (the colonial state, with constitutional reforms, before Independence; and the Indian republic thereafter).[83]

As a corollary to the increasingly heterogeneous state, I take the position in this thesis that not all STM in the interwar years is best understood as 'colonial' (or, for that matter, as putatively 'national'). As Mark Harrison has argued, the intimate relationship of science with colonialism is not to be denied, but we must note that the 'nature [of science] was not defined by colonialism alone.'[84] Indeed recent works have emphasised the importance of international, extra-imperial networks in the growth of science and technology in India. Ross Bassett, for

[80] Arnold, *Science, Technology and Medicine in Colonial India*, p. 2.
[81] *Ibid.*, Chapter 6.
[82] Pratik Chakrabarti, '"Signs of the Times": Medicine and Nationhood in British India', *Osiris*, Vol. 24, No. 1 (2009), pp. 188-211.
[83] Roger Jeffery, 'Recognizing India's Doctors: The Institutionalization of Medical Dependency, 1918-39', *Modern Asian Studies*, Vol. 13, No. 2 (1979), pp. 301-326; Roger Jeffery, 'Allopathic Medicine in India: A Case of Deprofessionalisation?', *Economic and Political Weekly*, Vol. 13, No. 3 (21 January 1978), pp. 101-103 + 105-113.
[84] Harrison, 'Science and the British Empire', p. 63.

instance, studies a group of Indians who studied at the Massachusetts Institute of Technology before Independence, funded largely by princely rulers. These engineers, some of whom set up Swadeshi industries or joined the nationalist movement upon their return to India, 'serve as a significant point of origin for a technological identity defined in relation to the United States.'[85] Chapter 6 of this thesis, which focuses on the technical experts of the Tatas' steel company, explores another instance of this phenomenon in the shape of the American and America-trained Indian engineers who were central to the running of the works.

The foregoing critique of the literature on Science, Empire and Nation and the alternative approach discussed above lead on to the major foci of this thesis. In studying engineers, I focus on a prominent group of STM practitioners. My focus on Indianisation and industrialisation demonstrates how the engineering profession shaped and was shaped by important political developments in our period. In doing this I not only pay attention to the differing experiences of practitioners depending on their race, but also study engineers as an integral part of wider Indian history.

Engineers in interwar India

As essential components of the Public Works Department and Railways, engineers were important to Indian government bureaucracies in the period 1900-47. They also played a central role in the newly emerging large-scale industries. Yet surprisingly, there exist few studies of engineers in India, especially in the interwar period. There are some useful works dealing with engineers in the long nineteenth century, such as Ian Kerr's study of the construction of the Indian railways, and David Gilmartin's analysis of 'colonialism and irrigation technology' in the Indus river basin. Kerr, whose book is essentially a labour history, concentrates on how the mostly European railway engineers handled the 'problems of management', relying for instance on Indian contractors to mobilise 'native' labour. Gilmartin argues that after the construction—in the 1880s—of a network of irrigation canals in the Indus Basin, irrigation engineers and civil administrators' ideas of how to run the canal system clashed: while the former believed in engineering solutions, the latter believed in paying heed to local customs and ideas of community and hereditary rights.[86] A valuable work for a later period is Daniel Klingensmith's chapter on A.N. Khosla and Kanwar Sain as practitioners of 'nationalist engineering', in his

[85] Ross Bassett, 'MIT-Trained Swadeshis: MIT and Indian Nationalism, 1880–1947', *Osiris*, Vol. 24, No. 1 (2009), pp. 212-230; quoted text from p. 214.
[86] Ian J. Kerr, *Building the Railways of the Raj* (Bombay and Oxford: Oxford University Press, 1995); David Gilmartin, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', *The Journal of Asian Studies*, Vol. 53, No. 4 (November 1994), pp. 1127-49.

book on dams and ideas of development in India and the USA, which is concerned primarily with the late- and post-colonial India of the 1940s and 1950s.[87] A rare exception in covering the interwar period, although it focuses on one province, is a recent doctoral thesis by Y. Srinivasa Rao on the introduction and development of electricity in the Madras Presidency in the years 1900-47. Engineers, both British and Indian, along with provincial legislators, appear in Rao's account as key actors in the debates on the nature of electricity generation projects best suited for the Presidency.[88] Overall, however, we do not have a pan-Indian picture of engineers working in the interwar era. The present thesis seeks to provide this, taking as its subject engineers throughout British India in the period 1900-47.

Historical and contemporary accounts use the terms 'engineering' and 'engineer' to denote a wide variety of activities and practitioners at different points in time and in different locations. For the purposes of this study, I have considered as an engineer anyone to whom at least one of the following descriptions applies:

1. Holder of an engineering degree or diploma from an institution in Britain, India, or (in the case of industrial engineers) any other country;
2. Member of one or more of the professional engineering societies in London or in India;
3. Officer in the Indian Public Works Department (PWD), or in the Engineering or other technical department (e.g. Traffic) of a state-run or company-run railway;
4. Royal Engineer employed in one of the above services;
5. Technical expert in a supervisory/ managerial position (above but not including foreman level) in an industrial enterprise.

Independent consulting engineers were few, and rarely feature in this study. The term 'engineer' here is taken to include all branches of engineering—identities crystallised to a large extent around one's bureaucratic (or, in industries, departmental) allegiance. As is apparent from the definition above, I have not included engineers of the Post and Telegraphs department of the Government of India, as they were very few in number.[89] I have chosen to focus on the most

[87]Daniel Klingensmith, *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007), Chapter 5.
[88] Y. Srinivasa Rao, 'Electrification of Madras Presidency, 1900-1947' (PhD thesis, Indian Institute of Technology Madras, 2007).
[89] The technical officers in Telegraphs numbered in the region of 40 in 1929 (*India Office List* for 1929), whereas their counterparts in the Public Works Department were several hundred in number and in the railways more than a thousand (see Chapters 4 and 5).

numerous and prominent groups of government engineers, those in public works and the railways.

In this thesis I address engineers collectively, as members of government services or industrial departments; and sometimes as individuals, but only where they are relevant to the overall themes addressed.[90] I treat these engineers as belonging to a 'profession'. My aim is not to test whether engineers in India constituted a profession in the strict sociological sense (of which more below).[91] Instead I use the concept of profession as a heuristic device that enables me to analyse the interactions between a diverse group of practitioners who nevertheless saw themselves as sharing some important characteristics and having common interests. Indeed the engineers in this study regularly referred to themselves as professionals, formed professional societies, sought higher status and a sense of community, and portrayed themselves as devoted to public welfare.

In studying engineers in India I have in mind the flexible concept of 'bureaucratic professions' as described by C.W.R. Gispen. Traditional theories of professions, Gispen argues, were developed for an Anglo-American free-market context, and modelled closely on medicine and law. Of the several attributes a profession is supposed to possess (esoteric knowledge, autonomy, monopoly of the market, the service ideal),[92] these theories stressed autonomy. Arguing that bureaucrats are not autonomous, they held that bureaucracies and professions were mutually exclusive. Yet many occupations that are not, by this yardstick, professions (e.g. 'the clergy, the officer corps, academics and civil servants') are nevertheless extremely compatible with other attributes supposed to characterise professions, such as 'community, monopoly, closure, service ethic, claims of disinterestedness, and specialized intellectual technique'.[93] It may be argued that the premium placed on the criterion of autonomy is at the heart of the well-known analyses of American engineers by Edwin Layton and David Noble, who view the dual

[90] For example, the famous engineer M. Visvesvaraya does not feature in this thesis as he operated in a princely state, Mysore, in our period, and in any case was more a technocrat-administrator than a practising engineer in this phase of his life. On Visvesvaraya's career as a technocrat, see Dhruv Raina, *Visvesvaraya as Engineer-Sociologist and the Evolution of his Techno-Economic Vision* (Bangalore: National Institute of Advanced Studies, 2001).

[91] Examples of studies that do this for other occupational groups are Paul Brassley, 'The Professionalisation of English Agriculture?', *Rural History*, Vol. 16, Issue 2 (2005), pp. 235-251; and Jeffery, 'Allopathic Medicine in India'.

[92] On the characteristics of professions, see for instance Jan Goldstein, 'Foucault among the Sociologists: The "Disciplines" and the History of the Professions', *History and Theory*, Vol. 23, No. 2 (May 1984), pp. 170-192, here p. 175.

[93] C.W.R. Gispen, 'German Engineers and American Social Theory: Historical Perspectives on Professionalization', *Comparative Studies in Society and History*, Vol. 30, No. 3 (July 1988), pp. 550-574; the quote is from p. 556. The term 'bureaucratic professions' appears, for instance, on p. 557, footnote 27.

loyalties of engineers to their corporate employers and to the wider profession as fundamentally incompatible.[94] Yet engineers, a large proportion of whom are employed in governments and private companies, seldom possess complete autonomy.[95] In this respect the experience of continental European engineers in the nineteenth century is particularly relevant to the present study, as a large proportion of them, as in the case of Indian engineers, were civil servants. Whereas Terry Shinn, writing about France, views such engineer-bureaucrats as forming 'corps' as opposed to the 'profession' of industrial engineers,[96] the present study views both types of engineers as belonging to a common profession. This was symbolised by the post-Great-War establishment of an all-India professional society in Calcutta, which included government as well as industrial engineers as members (see Chapter 3).[97]

Structure and sources

Covering the period 1900-47, but focusing largely on the inter-war period, the chapters that follow address developments in the engineering profession across the provinces of British India. (They do not directly address the princely states, which had their own, separate public services.) As mentioned earlier, these developments are studied in relation to *Indianisation* and *industrialisation*. The issues represented by these two terms, which became the leitmotifs of policy debates after World War I, are discussed in detail in Chapter 2. Against this backdrop, Chapter 3 analyses, through the lens of professional engineering societies, the interrelationships between different types of engineer, and developments in the profession as a whole. It traces the founding (in 1920) and development of the Institution of Engineers (India), the first pan-Indian professional institution for engineers. Through an analysis of membership statistics of this

[94] Edwin T. Layton, Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Baltimore: Johns Hopkins University Press, 1986); David F. Noble, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford: Oxford University Press, 1979). See also Peter Meiksins's critique of Layton. Meiksins argues that the 'revolt' described by Layton was not a case of engineers fighting for autonomy from the bureaucratic hierarchies they were a part of; instead, they were agitating for better salary and prospects of promotion *within* the bureaucracies employing them. Peter Meiksins, 'The "Revolt of the Engineers" Reconsidered', *Technology and Culture*, Vol. 29, No. 2 (April 1988), pp. 219-246.

[95] See the discussion of Magali Larson's work by Gispen in his 'German Engineers', pp. 555-6.

[96] Terry Shinn, 'From "corps" to "profession": the emergence and definition of industrial engineering in modern France', in Robert Fox and George Weisz (eds.), *The Organization of Science and Technology in France 1808-1914* (Cambridge: Cambridge University Press, 1980), pp. 183-208.

[97] A somewhat similar situation is described by Gispen for German engineers in the nineteenth century. He argues that in the Verein deutscher Ingenieure, the major professional engineering institution of the time, bureaucratic and entrepreneurial professionalism balanced each other, keeping the institution in a kind of stasis. Gispen, 'German Engineers', pp. 565-572.

institution and of its older counterparts in London (of which many engineers in India were members), the chapter demonstrates the growing importance of industrial engineers, and the emergence of an Indian identity in a profession that was earlier oriented towards the imperial metropolis.

Chapters 4, 5 and 6 of this thesis are organised on the basis of the sectors in which engineers were employed: public works, railways, and private industry respectively. Chapter 4 studies the reorganisation of the engineering cadres in the Public Works Department (PWD) in our period. Here I argue that a PWD engineer was seen first as a gentleman officer and only then as a technical expert; and that colonial officials and British legislators deployed this paradigm when, following the interwar constitutional reforms, they argued for the need to limit the extent of Indianisation and the powers of provincial governments in PWD work. In Chapter 5 I qualify the historiographical view that the nationalist movement drove the history of the railways in interwar India. I show that as in the case of the PWD, the colonial government tried to manage Indianisation so as to maintain the existing bureaucratic character of the railways. Extending Daniel Headrick's claim, I demonstrate that such Indianisation as did occur was due not only to the recruitment of more Indians, but to the exit of European engineers during the Depression and World War II. Chapter 6, a study of the technical experts of the Tata Iron and Steel Company (TISCO), describes a contrasting process of Indianisation, one which was not as dependent on the colonial state or its education system. TISCO had a multi-national team of technical experts, the most senior of them from America, to which was added a steady stream of Indians trained abroad (mostly in the USA; some in Germany and Britain) or in TISCO's in-house training institute, set up in 1921. Thus the chapter adds a study of technical practitioners to economic historians' analyses of Indian industrialisation, which concentrate on factors such as economic protection and the availability of capital.

This analysis relies on both quantitative and qualitative research methods. Statistics are compiled to establish the extent of Indianisation, the size of the engineering cadres and the membership of various professional institutions, all of which are important parts of my arguments. The relevant data is compiled from a wide range of sources. These include government reports, e.g. annual reports of the Railway Board, reports of specially appointed commissions, and the *Moral and Material Progress* statements submitted annually by the India Office to the British Parliament; records of service of government servants; and topographical membership lists, annual reports and other publications of British and Indian professional societies. In addition to quantifiable data, these sources, along with others (e.g. annual reports and other publications of the Tata Iron and Steel Company; personal papers of individual

engineers; obituaries in company magazines, newspapers and professional journals) are used to build up a picture of engineers' educational qualifications and career trajectories. To explore contemporary ideas about engineers and engineering (e.g. engineers' perception of themselves and their social status; policymakers' ideas on race and engineering ability), I study statements by and about engineers in various forums. These include published and unpublished memoirs and biographies; trade magazines such as *Indian Engineering* and the *Indian Railway Gazette*; and debates in the Indian central legislature and in the British Parliament.

Many of the sources mentioned so far were consulted in the Asia Pacific and Africa Collection (APAC) of the British Library in London. Also important were two as yet under-utilised sources on the open shelves of the APAC, the annual *India Office List*s (brought out by the India Office) and the privately produced almanac, *Thacker's Indian Directory*—both invaluable references for details on official appointments and bureaucratic regulations. Data related to the Institutions of Civil, Mechanical and Electrical Engineers in London and the Institution of Engineers (India) in Kolkata (formerly Calcutta) were obtained from their respective archives.[98] A rich collection of private papers, administrative files and correspondence from the interwar period—most of which I believe have not been used before by historians—was examined at the Tata Steel Archives in Jamshedpur. Finally, many sources were accessed via online/ digitised archives. These include government reports from the Digital Library of India, online *Proceedings* of the Institution of Civil Engineers and the Institution of Mechanical Engineers, the ProQuest online database of House of Commons Parliamentary Papers, and the online Hansard (transcripts of British parliamentary debates).

[98] The archives of the Institution of Electrical Engineers (IEE) are held at its successor institution, the Institution of Engineering and Technology (IET), London.

CHAPTER 2

Indianisation and Industrialisation in Indian History

Introduction

The focus of inquiry in this thesis, as outlined in Chapter 1, is to understand how developments in the engineering profession were caused by, and in turn influenced, the twin transformations of Indianisation and industrialisation in interwar India. In doing so, I both draw on and seek to make important advances to the existing literature on these two transformations. In this chapter, I begin by describing the approaches taken by historians who have addressed these processes, and situate the present study in relation to the literature. By reading key primary sources alongside the findings of the existing literature, I provide an overview of the course of Indianisation and industrialisation as they developed over the period 1900-47. This will provide essential context for the subsequent chapters, and serve as a point of departure for the arguments I develop in them about the relevance of engineers to these two processes in Indian history.

Indianisation, or the increasing of the number of 'native' employees in government service, was one of the central issues in Indian politics from 1858, when Crown Rule began, to 1947, when Independence was achieved. Despite its political importance, not many historians have studied the question in detail. A few studies concerned indirectly with the issue of Indianisation appeared in the 1970s and '80s. These were focused on the Indian Civil Service (ICS) and the changes that occurred in its composition and culture in the final decades of British rule. David Potter argued that one of the important reasons for the withdrawal of Britain from India in 1947 was that the British personnel it relied on to staff the civil services were dwindling, as fewer Britons opted to apply for Indian service from 1919 onwards. Asking why the popularity of the ICS fell among British applicants, he suggests that it was the inadequate terms of employment that worried them more than constitutional changes in India and the rise of the nationalist movement.[1] Ann Ewing, in contrast, has shown convincingly that political uncertainty, the hostility of nationalist politicians towards the elite European-dominated nature

[1] David C. Potter, 'Manpower Shortage and the End of Colonialism: The Case of the Indian Civil Service', *Modern Asian Studies*, Vol. 7, Issue 1 (1973), pp. 47-73, esp. p. 54. For a detailed description of the recruitment process for the ICS, see Potter's article and also T.H. Beaglehole, 'From Rulers to Servants: The I.C.S. and the British Demission of Power in India', *Modern Asian Studies*, Vol. 11, Issue 2 (1977), pp. 237-255.

of the ICS, and the decrease in powers of ICS officers under the changing system of government in the interwar years was a serious source of 'discontent' in the ICS, and of worry to the government in Britain and in India.[2] A recent book by Malti Sharma tracing debates on the Indianisation of the ICS in the years 1858-1935 demonstrates that the expanding role of Indians in the Indian legislative councils in the twentieth century provided a key impetus to Indianisation in the ICS.[3]

Thus the issue of Indianisation has usually been viewed in relation to the ICS, which was perhaps the most prestigious and powerful of the services. Yet there was a multiplicity of services in our period, and Indianisation as a political issue applied to all of them. Inasmuch as it recognises this fact, J.D. Shukla's 1982 study of Indianisation is a rare exception. Shukla analyses Indianisation across several 'All-India Services'[4] such as the Indian Police, Indian Service of Engineers, and Indian Educational Service in addition to the ICS. The book is a valuable overview of the terms and recommendations of various government commissions set up to look into the organisation of the services (including their racial composition) at the time of constitutional reforms, and shows the general trends in the changing proportion of Indians in various services.[5] As a means of understanding the Indianisation of engineers and their role in interwar India, however, Shukla's study has significant limitations. The Indian Service of Engineers (ISE) is only one of several government services, technical and non-technical, covered in Shukla's book; therefore the particular features of engineers' roles and experiences are largely neglected. Further, the important case of railway engineers is outside the scope of Shukla's study (as the railway officers did not form an 'All-India Service'—see below), as is another type of Indianisation, that of technical personnel in private industry.

In this thesis I address these omissions by exploring the Indianisation not only of the ISE—whose officers staffed the Public Works Department—but also of technical officers in the Indian railways (privately run as well as government-run) and of the technical experts of a prominent heavy industrial enterprise (Chapters 4, 5 and 6).[6] I also go beyond Shukla in

[2] Ann Ewing, 'The Indian Civil Service 1919-1924: Service Discontent and the Response in London and in Delhi', *Modern Asian Studies*, Vol. 18, Issue 1 (1984), pp. 33-53.
[3] Malti Sharma, *Indianization of the Civil Services in British India (1858-1935)* (New Delhi: Manak Publications, 2001).
[4] The term is explained later on in this chapter.
[5] J.D. Shukla, *Indianisation of All-India Services and its Impact on Administration* (New Delhi: Allied Publishers, 1982).
[6] Ian Kerr and Daniel Headrick briefly comment upon Indianisation in the railways, while Headrick also gives a short account of Indianisation in private industry**.** I engage with these studies in Chapters 5 and 6. The works referred to are Ian J. Kerr, *Engines of Change: The Railroads That Made India* (Westport, CT and London: Praeger, 2007), Chapter 6; Daniel R. Headrick, *The Tentacles of Progress: Technology*

considering the Indianisation of engineers not only in relation to the government services, but as a larger issue, closely related to the educational backgrounds, identities, and work culture of engineers in our period.

The other major process addressed in this chapter is the growth of industries in our period, especially after World War I. The nature of this process of 'industrialisation' in interwar India is a much-discussed topic in the economic history literature. As Rajnarayan Chandavarkar has noted, scholars have mostly conceptualised industrialisation as an idealised, teleological process, against which India's interwar industrialisation appears as incomplete or limited.[7] Thus R.K. Ray is concerned with why the 'private corporate sector' failed 'to transform the economy from a predominantly agricultural to a predominantly industrial one', while Dietmar Rothermund writes of 'the limits of industrialisation under colonial rule' in the long nineteenth century, and of 'the Indian economy, which continued to suffer from the chronic disease of colonial paralysis' in the period after World War I.[8] The result, Chandavarkar argues, is an exercise in apportioning the blame for a supposedly incomplete industrialisation 'between the baneful effects of colonial rule [and] the timeless torpor of Indian society.'[9] In the former category we might place the colonial government's fiscal policy and inadequate protection of Indian industry; in the latter low domestic demand, insufficient capital, and the reluctance of industrialists to take risks.[10]

Yet if we were to ask a positive historical question (to what extent did industry grow?) instead of the negative one privileged by the literature (why was industrialisation limited/incomplete?), then the findings of this literature can be seen in a different light, as providing considerable evidence for a marked growth in industry. R.K. Ray writes that '[o]n the whole there [was] substantial progress in regard to the expansion of the industrial complex as well as the Indianization of corporate enterprise. At the end of British rule, India had a larger industrial sector, with a stronger element of indigenous enterprise, than most underdeveloped

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Transfer in the Age of Imperialism, 1850-1940 (New York and Oxford: Oxford University Press, 1988), Chapter 9 and pp. 371-4.

[7] Rajnarayan Chandavarkar, 'Industrialization in India before 1947: Conventional Approaches and Alternative Perspectives', *Modern Asian Studies*, Vol. 19, No. 3 (Special Issue, 1985), pp. 623-668, esp. p. 664.

[8] Rajat K. Ray, *Industrialization in India: Growth and Conflict in the Private Corporate Sector 1914-47* (New Delhi: Oxford University Press, 1982 [1979]), p. 1; Dietmar Rothermund, *An Economic History of India: From Pre-Colonial Times to 1991*, 2nd edn (London: Routledge, 1993), quoted text from title of Chapter 5 and from p. 64.

[9] Chandavarkar, 'Industrialization in India before 1947', p. 635 and p. 664.

[10] A.K. Bagchi's argument on protection, as described in Tirthankar Roy, *The Economic History of India 1857-1947*, 2nd edn (New Delhi: Oxford University Press, 2006), p. 263; Rothermund, *An Economic History of India*, pp. 61-5; Ray, *Industrialization in India*, p. 3, p. 81, and Chapter 4.

countries of the world.'[11] Macroeconomic data support this verdict. Tirthankar Roy has shown that large-scale industry in particular expanded: employment in this sector grew from 0.88 million in 1911 to 1.57 million in 1921, staying at that figure in 1931. Large-scale industry's share of industrial income had been 15 per cent in 1900; in 1947 it was around 40 per cent.[12] It is this aspect of India's industrialisation that is relevant to my enquiry in this thesis. There may have been many failed ventures, and India may still have been a mainly agricultural economy at the end of our period; nevertheless industries, especially large-scale industries, grew—and with them the importance of industrial engineers. The crucial role of these engineers in the interwar growth of industries is largely neglected in the literature. The present thesis, through its detailed study of the role of technical experts in a prominent interwar industrial enterprise (the Tatas' steel company), highlights this important dimension of the industrialisation process (Chapter 6). At the same time, it also pays attention to the effect of growing industry on engineering as a profession in interwar India (Chapter 3).

I will begin by describing the growth of Indianisation as a political idea in the long nineteenth century. Subsequently, I deal with the public services in twentieth-century colonial India, the evolution of their structure in relation to constitutional reforms, and government policy on their Indianisation. In the final section I discuss Indian industrialisation, and how the growth of large-scale industry was influenced by World War I and the government's interwar fiscal policy. I conclude by outlining the way in which these two processes were related to the development of the engineering profession in India, a theme which is taken up in subsequent chapters.

The Early History of Indianisation

In its literal sense, 'Indianisation' in colonial India referred to a bureaucratic process—the replacement of Britons by Indians in legislative bodies, government administration, and private enterprises. But Indianisation was always more than this. It was a political idea, a theme central to the negotiations between colonial officials and nationalist politicians in the twentieth century.

[11] R.K. Ray, *Industrialization in India*, p. 1.
[12] T. Roy, *The Economic History of India*, pp. 186-7 (including Table 6.3) and Chapter 6 in general.

This is best captured by the words of H.N. Kunzru of the Servants of India Society,[13] who, criticising the government's attitude to Indianisation, wrote in 1917:

> Our vital interests are bound up with the proper solution of this question, which is at once moral, political and economic. It affects our manhood. It involves our national self-respect. It is a test, also, of England's good faith. If she is mindful of her moral responsibilities, if her dominion in India is not to be synonymous with the exploitation of a helpless people, if the Act of 1833 and the Proclamation of 1858 are not mere scraps of paper, it is her bounden duty to raise Indians to positions of trust and responsibility, and to make them feel that they are not treated as helots in their own country.[14]

As this statement suggests, the issue of Indianisation had its roots in the nineteenth century. In its Charter of 1833, the East India Company had declared a policy of encouraging the selection of Indians for government service. When Crown replaced Company as the ruler of India a year after the Mutiny of 1857, Queen Victoria proclaimed to the Indian populace that suitably qualified British subjects, irrespective of their race, would be selected to serve the government. In the following decades the scope for employment by the government increased as its administrative bureaucracies grew larger and more specialised. It was also recognised that significant savings could be made by employing Indians, who were paid lower salaries than their British counterparts. Despite all these conditions, a belief in the racial inferiority of Indians—exacerbated by late-nineteenth century social-Darwinist beliefs—ensured that the government rarely appointed them to responsible positions, one Viceroy suggesting in private that assurances of doing so were insincere.[15]

Simultaneously, a national consciousness was growing among the urban educated classes. At the annual meetings of the Indian National Congress, formed in 1885, members 'gently reminded' the government of Victoria's promise of a greater Indian share in government posts, although their demands were modest and changes were sought largely within the existing constitutional framework.[16] This constitutional system was one in which Indians had no executive powers. Despite the existence of Legislative Councils at the central and provincial

[13] The Servants of India Society was a social reformist organisation established in 1905 by G.K. Gokhale. See Barbara D. Metcalf and Thomas R. Metcalf, *A Concise History of India* (Cambridge and New York: Cambridge University Press, 2003 [2002]), p. 140.
[14] Hirday Nath Kunzru, *The Public Services in India (Political Pamphlets—II)* (Allahabad: Servants of India Society, 1917), p.1.
[15] Burton Stein, *A History of India,* 2nd edn, edited by David Arnold (Oxford: Wiley-Blackwell, 2010), pp. 239-43; Metcalf and Metcalf, *Concise History of India*, p. 103.
[16] Stein, *History of India*, pp. 275-6.

levels, there were no elections, and the majority of members nominated were civil servants, most of them Europeans. The following figure shows the structure of the executive and legislative arms of government as of 1905:

***Figure 2.1**: Structure of Indian government, 1905* [17]

Government of India
Viceroy and Governor-General: Lord Curzon of Kedleston
[Reports to Secretary of State for India, a Cabinet minister responsible to the British Parliament]

COUNCIL

Ordinary Members
Major-Gen. Sir E.R. Elles (Military); Sir A.T. Arundel; Sir D.C.J. Ibbetson; H. Erle Richards (Law); J.P. Hewett; E.N. Baker (Finance)

Extraordinary Member
General Viscount Kitchener of Khartoum (Commander-in-Chief)

Additional (Nominated) Members

Official Members
H. Adamson (representing Burma); L.A.S. Porter (United Provinces); A.D. Younghusband (Bombay); L. Hare (Bengal); H.A. Sim (Madras)

Non-Official Members
G.K. Gokhale (representing Bombay); E. Cable (Calcutta Chamber of Commerce); Nawab Saiyid Muhammad Sahib Bahadur (Madras); *Rai Bahadur* B.K. Bose (Central Provinces); Sir Rameshwara Singh, Maharaja Bahadur of Darbhanga (Bengal); *Rai* Sri Ram Bahadur (United Provinces); Nawab Fateh Ali Khan, Kazilbash (Punjab)

Presidency of Madras
(example of provincial government structure)

Governor: Arthur Oliver Villiers (Lord Ampthill)

COUNCIL

Members of Council
Sir J. Thomson; Gabriel Stokes

Additional members for legislation

Officials
C.J. Weir; R.V. Srinivasa Aiyar, *Diwan Bahadur*; J.N. Atkinson; A.G. Bourne; H. Bradley; A.E.C. Stuart; Sir V. Bhashyam Aiyangar, *Diwan Bahadur*; J.E.P. Wallis; J. Twigg; G.S. Forbes

Non-officials
L.A. Govindaraghava Aiyar; K. Vasudeva Aiyangar; G. Srinivasa Rao; M. Krishnan Nayar; K. Venkata Rao; Sir G.G. Arbuthnot; Ghulam Muhammad Ali, *Sahib Bahadur*, *Khan Bahadur*; H.P. Hodgson; C. Muttukumaraswami Mudaliyar, Zamindar of Chunampet; P.S. Sivaswami Aiyar; V.C. Desikachariyar.

Note: Diwan Bahadur, Rai, Rai Bahadur, Khan Bahadur etc. refer to honorific titles awarded by the colonial government to Indians.

[17] *India Office List* for 1905, p. 7 and p. 75.

As Figure 2.1 shows, the government was made up of representatives of the Crown, and nominees—there were no elected members. At the centre, the Governor-General and his Executive Council (the ordinary and extra-ordinary members in the figure) formed the executive, while the additional members formed the rest of the legislature. Of these, the 'official' members were government officers and mostly Britons, while the 'non-official' members were mostly Indian and appointed from among the rest of the public. In every legislature the officials had a majority over the non-officials. The situation at the provincial level was analogous, the Governor and his ordinary members forming the executive.[18]

Although the Indian National Congress had begun as a group of peaceful petitioners, a more radical view was taken by some sections of the Congress around the turn of the twentieth century, and in the 1900s there emerged a group of 'extremist' leaders such as Lala Lajpat Rai and Bal Gangadhar Tilak. An important stimulus to the radicalisation of their politics was the partition of Bengal in 1905 under the Conservative Viceroy Curzon. Introduced on the pretext of administrative convenience, the proposal for partition was generally seen as a ploy to split the nationalists in the populous presidency on religious lines—eastern Bengal had a majority Muslim population, and the western half a Hindu majority. When petitions against the move went unheeded, protests broke out, and measures such as the boycott of British goods and government schools were adopted. Bengal was partitioned nevertheless; but protests continued in various parts of the country as the radicals grew more influential. Shortly after the partition, a Liberal Secretary of State for India (i.e. the Cabinet minister in the British Parliament to whom the Viceroy of India reported), John Morley, took up office in London, and a new Viceroy, Lord Minto, took over from Curzon in India. In what has been seen as an effort to wean the Congress away from its radical leaders and keep them with the 'moderate', constitutionalist ones, they proposed a set of constitutional reforms (known as the Morley-Minto Reforms), which culminated in the Indian Councils Act of 1909.[19]

Under the new Act, the strength of the central and provincial legislative councils was increased—to 60 at the centre, and to more than twice the previous size in most provinces. For the first time, Indians were appointed to the executive councils of the Governor-General at the centre and the governors in the provinces. Elections were introduced for some of the seats in the provincial legislative councils, although the franchise was limited on the basis of income, and

[18] On official and non-official members see Metcalf and Metcalf, *Concise History of India*, p. 103.
[19] Stein, *History of India*, Chapter 7. Minto became Viceroy in 1905. John F. Riddick, *The History of British India: A Chronology* (Westport, CT: Praeger, 2006), p. 91. The partition of Bengal was revoked in 1911. Stein, *History of India*, p. 286.

separate electorates were provided for different communities. Although Indians elected to the provincial legislatures had no executive powers—as the Governor's executive council continued to consist of appointees—the proportion of non-official members was now increased to give them a majority in the legislature, although at the centre there was still an official majority. Furthermore, members were now allowed to introduce resolutions in the councils as a means of showing their dissatisfaction with government decisions.[20]

Thus the Morley-Minto reforms constituted the first notable step in Indianising the political system. But no appreciable steps had as yet been taken to increase the limited opportunities for Indians in administrative jobs in government. This was in spite of continuous agitation on the part of Indian politicians for reforms in the composition of the Indian Civil Service (ICS), the predominantly European members of which dominated the most prestigious government appointments. A particular demand was the holding of simultaneous entrance examinations to the ICS in Britain and India, so that Indians would not be obliged to travel to London to take the examination. These demands were mostly ignored, Curzon being particularly intransigent during his tenure as Viceroy.[21] Even under existing conditions, he felt that 'higher posts that were meant and ought to have been exclusively and specially reserved for Europeans [were] being filched away by the superior wits of the native in the English examinations.'[22]

Yet the Indianisation of the legislative councils, which had begun with the Morley-Minto reforms, gave an impetus to Indianisation in the administrative services in the interwar years, as shown in the following section.

Constitutional reforms and the Indianisation of the public services

The public services, 1900-19

In the twentieth century, the terms of the Indianisation debate grew to include not only the ICS, but all the public services of the government, which now depended on a complex set of

[20] *Royal Commission on the Public Services in India. Report of the Commissioners,* Vol. I (Cd. 8382, London: HMSO, 1917), p. 16; Stein, *History of India*, pp. 284-5; Riddick, *History of British India*, p. 94. The first of these sources is hereinafter cited as *Islington Commission Report.*

[21] Sharma, *Indianization of the Civil Services*, Chapter IX.

[22] Curzon to Hamilton, 23 April 1900, quoted in Sharma, *Indianization of the Civil Services*, p. 162. Lord George Hamilton was Secretary of State for India, 1895-1903. Riddick, *History of British India*, p. 270.

bureaucracies.[23] Before discussing the Indianisation of the services, it will be useful to outline the main features of this bureaucratic set-up in the period 1900-20.

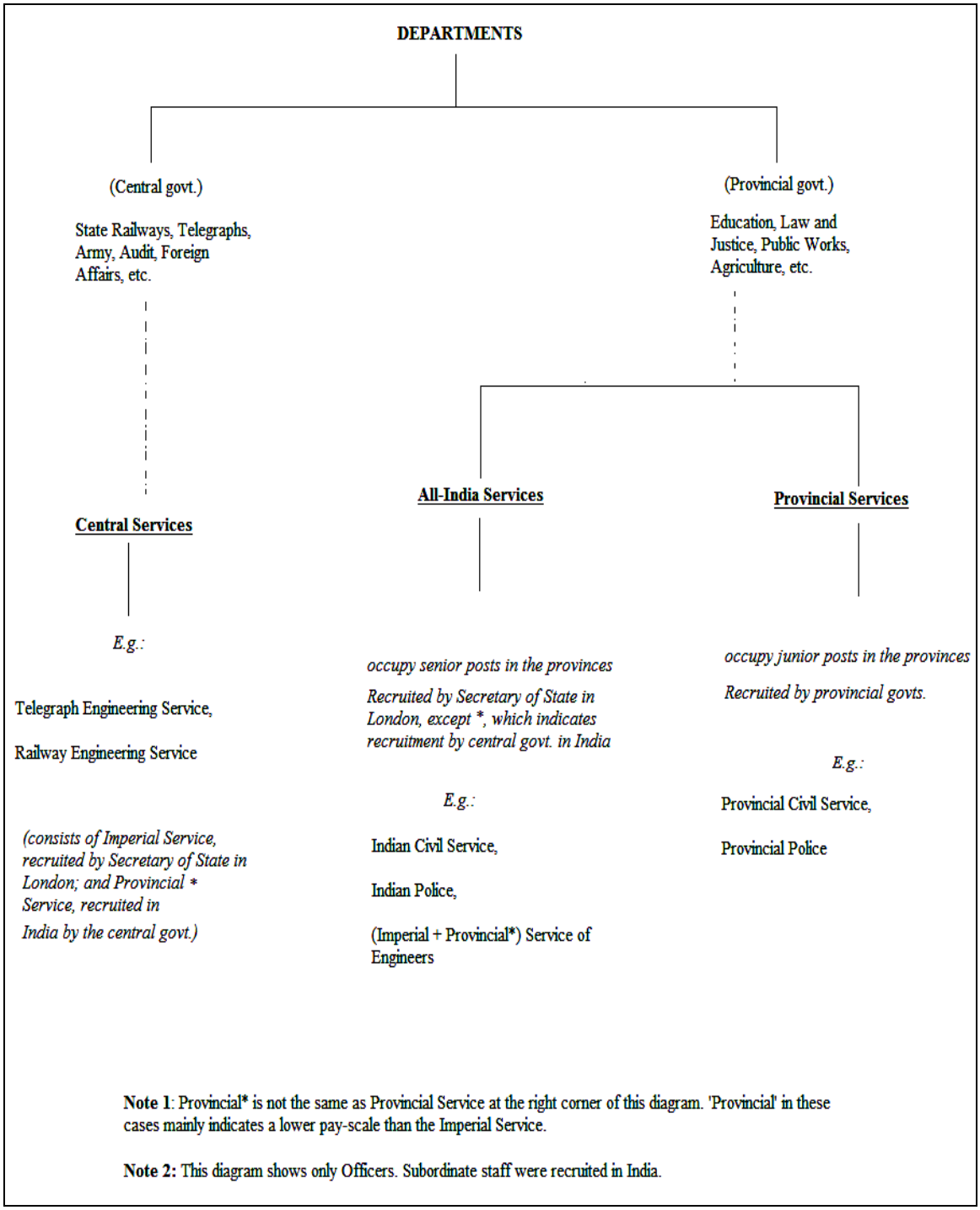
Government administration was carried out through a number of departments. Some of these departments were directly under the central government (e.g. foreign affairs, the army, telegraphs, state-run railways[24]) while others were run by the provincial governments (e.g. law and justice, education, income tax, public works). The officer ranks of the departments were staffed by members of various administrative services, which were 'reservoirs of trained men' created for this purpose.[25] Figure 2.2 shows the different types of department and service, and the relationships between them:

[23] The intensification of bureaucracy had begun after Crown Rule was instituted. Metcalf and Metcalf, *Concise History of India*, p. 103.

[24] Railways run by the state (usually referred to simply as 'state railways') as opposed to railways managed by private companies. For an explanation of the different kinds of railway, see Chapter 5.

[25] L. Curtis (ed.), *Papers relating to the application of the principle of Dyarchy to the Government of India: To which are appended the Report of the Joint Select Committee and the Government of India Act, 1919, with an Introduction by L. Curtis* (Oxford: Clarendon Press, 1920), Part IV: 'The Structure of Indian Government (*June 1917*)'. The quoted text appears on p. 206. This volume is hereinafter cited as Curtis (ed.), *Papers relating to Dyarchy*.

Figure 2.2: *Government administration, c. 1900-20: departments and services* [26]



[26] Reconstructed on the basis of several sources including Curtis (ed.), *Papers relating to Dyarchy*, Part IV; *Islington Commission Report; East India (Civil Services in India). Report of the Royal Commission on the Superior Civil Services in India* (Cmd. 2128, London: HMSO, 1924) (hereinafter cited as *Lee Commission Report*); Shukla, *Indianisation of All-India Services*. See the note below on the terms 'Central Service' and 'All-India Service'.

As the diagram shows, there were three major types of service in early-twentieth-century India: Central, All-India and Provincial.[27] The Central Services provided the staff required for those departments that operated directly under the central government, e.g. Telegraphs and state railways. Their members were recruited from two sources: in London, by the Secretary of State's India Office (and in some cases from among fresh Royal Engineer officers); and in India, by the central government. Members of the All-India Services staffed the departments operating primarily in the provinces, such as Education and Law (Police). They were recruited entirely by the India Office in London (with one prominent exception in Public Works, which will be discussed below). Members of the Provincial Services were recruited in the respective provinces. They worked in provincial departments alongside members of the corresponding All-India Service, but holding positions of lesser responsibility. While the All-India officers could in theory be transferred to another province or to the central government, provincial officers spent their entire career in one province.[28]

In two cases, those of public works engineers and railway engineers, the term 'Provincial Service' was used in a potentially confusing sense. In state railways as well as the Public Works Department (PWD), the officers recruited in England (who were mostly Europeans) were called the 'Imperial Service' while those recruited by the central government in India were called the 'Provincial Service', composed essentially of Indians, Eurasians, and Europeans permanently resident in India. These Provincial Services were different from the usual ones in that the work their members did was in no way different from that of the Imperial engineers; they could also attain the same ranks. Here the word 'provincial' only denoted the fact that they were recruited in India, and that their salary and terms of employment were different from those of the Imperial Service engineers.[29]

There were two main methods of recruitment to the public services in this period: competitive examinations and 'nomination'.[30] Recruitment of officers in England was carried out through competitive examinations in some prominent services like the ICS and Indian

[27] It is not clear when the distinction between 'All-India Service' and 'Central Service' was first made. Both terms were used in the *Lee Commission Report* (1924), while the term 'all-India service' was mentioned in the Montagu–Chelmsford Report of 1918: *East India (Constitutional Reforms). Report on Indian Constitutional Reforms* (Cd. 9109, London: HMSO, 1918), paragraph 240, p. 195. For the sake of clarity and continuity, I use the terms 'All-India' and 'Central' here starting from the period 1900-20: the distinct features defining each were already evident in this period.

[28] See references under Figure 2.2; in particular *Islington Commission Report*, pp. 18-19, and *Lee Commission Report*, p. 3.

[29] *Islington Commission Report*, pp. 18-19.

[30] The reference for the rest of this passage, except where another citation is given, is *Islington Commission Report*, pp. 28-31.

Police.[31] In others, recruitment was by 'nomination', though the term had a more general meaning than its present one. In the Engineering Services of the PWD and state railways, for example, the Secretary of State called for applications, and a selection committee was appointed to assess the candidates' qualifications and subsequently invite some for an interview at the India Office, on the basis of which they would be selected. (There were some additional requirements: candidates had to pass a medical examination and a riding test before they could be confirmed.)[32] Nomination was also the norm in recruiting officers in India, where, with one minor exception, no competitive examinations were held before the end of World War I.[33] In some cases a system of 'patronage' existed—for instance, Provincial Service engineers for the PWD were selected from the Indian engineering colleges according to a fixed quota for each college.[34] External recruitment was sometimes supplemented by promotion from a lower service within the department. Thus, in a small number of cases, candidates were promoted from a Provincial Service to the corresponding Imperial Service; and occasionally, subordinate employees were promoted to the Provincial Service in the same department.[35]

The size of the public services varied according to the nature and importance of the associated tasks. In 1913 the sanctioned (i.e. prescribed maximum) strengths of some of the services were as follows:

[31] The competitive examination was sometimes mixed with nomination, as in the first few years after World War I, when British candidates were scarce in the exam, so that most British recruits were obtained by appointing men who had fought in the war. Potter, 'Manpower Shortage,' pp. 51-2.
[32] See 'Indian Public Works Department. Regulations as to Appointments of Assistant Engineers, 1910' in the *India Office List* for 1910, p. 222; Annexure XVIII: 'Public Works Department and Railway Department (Engineering Establishment)', *Islington Commission Report*, pp. 326-37, here p. 330.
[33] As of the 1910s, the only exception was 'in the Punjab, where out of the total number of candidates annually recruited two are appointed on the results of competitive examination among nominated candidates.' *Islington Commission Report*, p. 29.
[34] Annexure XVIII, *Islington Commission Report*, p. 331; see Chapter 4 of this thesis for more on PWD recruitment.
[35] *Islington Commission Report*, pp. 19-20.

Table 2.1: *Types and sanctioned sizes of public services as of 1913* [36]

Name of Service	***Type of Service***	***Strength***		
		Recruited in England	**Recruited in India**	**Total**
Indian Civil Service	All-India	1,350	61 [A]	**1,411**
Provincial Civil Services	Provincial		2,572	**2,572**
Agricultural Service (Imperial)	All-India	62	-	**62**
Agricultural Service (Provincial)	Provincial	-	56	**56**
Forest Service (Imperial)	All-India	213	-	**213**
Forest Service (Provincial)	Provincial	-	208	**208**
Police (Imperial)	All-India	661	10 [A]	**671**
Police (Provincial)	Provincial	-	255	**255**
Public Works Engineering & Railway Engineering	(All India & Central)	648 [B]	280 [C]	**928**
Telegraph Engineering	Central	23 [B]	23 [C]	**46**

Key:
A: By promotion from Provincial Service
B: Imperial Service
C: Provincial Service ('Provincial' in the sense of India-recruited members of an All-India or Central Service)

Source: Based on table in 'Minute by Mr. Abdur Rahim', *Islington Commission Report*, pp. 394-488, here pp. 395-6.

The organisation of the services and the system of recruitment were unfavourable to Indian aspirants in a number of ways. First, as Table 2.1 emphasises, the prestigious All-India Services were recruited in Britain, which meant nearly all their members were European. Although Indians were allowed to compete in most cases, few could afford to travel to Britain and acquire the required British qualifications or enter competitive examinations.[37] David Potter has calculated that in the years 1904-1913 (both inclusive), 501 out of 528 candidates selected to the ICS through the London examination were European, a proportion of 95 per cent.[38] In the case of the Indian Police, a candidate could only enter the London examination if he was 'a

[36] For confirmation that the figures in the table refer to sanctioned strengths, cf. Annexure XVIII, *Islington Commission Report*, p. 326, which gives the total sanctioned size of PWD and state railways engineering services together as 928.
[37] The difficulty of Indians in going to Britain to compete for Civil Service appointments was already being raised in the British Parliament in the late nineteenth century. See Sharma, *Indianization of the Civil Services*, pp. 143-6.
[38] Potter, 'Manpower Shortage', p. 49.

British subject of European descent'. In addition, 'at the time of his birth his father must have been a British subject, either natural born or naturalised in the United Kingdom.'[39]

Second, most Indian officers belonged to the Provincial Services, which, as mentioned earlier, implied lower status and a lesser grade of responsibilities than the Imperial officers. It also meant lower pay.[40] This was even true of the case of the exceptional Provincial Service in the PWD and the Railways, whose members were engaged in the same tasks as their Imperial Service counterparts and could attain the same ranks. Before World War I, the Provincial Service engineers were paid approximately two-thirds of what the Imperial engineers received, except at Chief Engineer rank, where both were paid equal salaries.[41]

The status of Anglo-Indians and Domiciled Europeans was contentious. The term 'Anglo-Indian' at this time usually referred to those of mixed European and Indian parentage (Eurasians), a community that had grown in India over two or more centuries. 'Domiciled European' referred to those of entirely European parentage but permanently resident in India, usually over multiple generations. As historians have shown, these categories (along with the simple 'European') were fluid, always contested, and susceptible to different interpretations depending on factors such as one's schooling and ownership of property in Britain.[42] In fact it appears that sometimes *both* categories were implied when reference was made either to 'the domiciled community' or 'the Anglo-Indian community'.[43] Anglo-Indians, Domiciled Europeans, and 'native' or 'Asiatic' Indians together were classed under the rubric of 'statutory natives of India'.[44] The non-Asiatic Indians, so to speak, occupied a large proportion of middle and higher level jobs in government service. In 1913, they accounted for 1,593 out of 11,064 government posts (14.4 per cent) with a monthly salary of Rs. 200 and above, whereas they

[39] Rule quoted in Annexure XVI: 'Police Department', *Islington Commission Report*, pp. 297-316, here p. 298.
[40] See *Islington Commission Report*, p. 19. 'Where there is a large body of work of a less important character to be done … it would obviously be extravagant to recruit officers to do it on the terms required to obtain men for a higher class of duty.'
[41] See *Historical Retrospect of Conditions of Service in the Indian Public Works Department. (All India Service of Engineers)*, Private pamphlet (c. 1925) in the Secretary of State's Library Pamphlets, Vol. 72, T.724 (APAC: P/T724), p. 2 and p. 8.
[42] See Elizabeth Buettner, *Empire Families: Britons and Late Imperial India* (Oxford: Oxford University Press, 2004); Laura Bear, *Lines of the Nation: Indian Railway Workers, Bureaucracy, and the Intimate Historical Self* (New York: Columbia University Press, 2007), esp. pp. 299-300 (note 17) and p. 140. See also Frank Anthony, *Britain's Betrayal in India: The Story of the Anglo-Indian Community* (Bombay: Allied Publishers, 1969) on the definition of 'Anglo-Indian' over time.
[43] See 'Minute by Mr. W.C. Madge', *Islington Commission Report*, pp. 386-91.
[44] *Islington Commission Report*, p. 23.

formed well under 0.1 per cent of the Indian population.[45] (In what follows, I use the term 'Anglo-Indian' to mean Eurasian. The term 'statutory native' or 'statutory Indian' will encompass Anglo-Indians, Domiciled Europeans and 'Asiatic'/'native' Indians).

Those who considered themselves 'native' Indians thus felt that they were being excluded from opportunities for government employment even in those branches of the services for which officers were recruited in India. The resentment was largely born of the fact that recruitment in India was by nomination, a system suspected of favouring Anglo-Indians and Domiciled Europeans. Certainly there was a disparity in the educational requirements stipulated for candidates of different categories. To be eligible for certain subordinate posts, Anglo-Indians and Domiciled Europeans, who were usually educated in schools meant exclusively for them, were only required to complete the 'European schools' curriculum, whereas 'native' Indians had to be university graduates; in the 1910s a government Commission proposed a similar system for officer appointments.[46] For their part, Anglo-Indians and Domiciled Europeans often expressed dissatisfaction that their terms and share of employment were not on par with that of the 'pure' Europeans.[47]

Expanded legislatures and the Islington Commission (1912-15)

Indian politicians were vocal in their protests against the disadvantaged position of Indians in the public services. At its annual meetings, presidents of the Indian National Congress reiterated the demand for reform in ICS recruitment, while in the newly enlarged Imperial Legislative Council, the Congress Moderate Gopal Krishna Gokhale was particularly active in raising the issue of Indian representation in the public services. In 1911, another Indian member of the central legislature, Subba Rao, moved a resolution asking that a commission be appointed to consider the question. The resolution received support from other Indian legislators. In addition,

[45] *Islington Commission Report*, table on p. 24; 'Minute by Mr. M.B. Chaubal', *Islington Commission Report,* pp. 373-86, here p. 379. The Islington Commission's figures cited here were for 'Anglo-Indians', which I have taken to include Domiciled Europeans as no separate figures were reported for that category.
[46] On the requirements for subordinate posts, see Buettner, *Empire Families*, p. 91. For officer positions, Anglo-Indians and Domiciled Europeans would have to pass 'an examination of a corresponding standard [to the university degree] in the European schools course'. Quoted in 'Minute by Mr. M.B. Chaubal', p. 381.
[47] 'Minute by Mr. W.C. Madge'; *Historical Retrospect of Conditions of Service* (cited above). The latter was a memorial to the Secretary of State from Domiciled European engineers in the PWD, asking to be given the same terms of employment as Europeans recruited in Britain.

according to Malti Sharma, the then Viceroy Lord Hardinge (1910-16) was favourably disposed towards Subba Rao's request, which was granted.[48]

As a result, the Royal Commission on the Public Services in India (Islington Commission) was set up in 1912. The Commission had twelve members, three of whom were Indians (including Gokhale, who died in 1915, before the Commission's Report was published). Of the remaining nine, at least one was Anglo-Indian, and the rest British.[49] Its task was to study the public services and make recommendations regarding the procedure for recruitment and training of officers; their pay and emoluments; and, most importantly, '[s]uch limitations as still exist in the employment of non-Europeans and the working of the existing system of division of services into Imperial and Provincial'.[50] The Commission carried out its study over the next three years, but because of wartime delays, the report was only published in 1917. Their main recommendations on the subject of Indianisation were as follows.

First, they addressed the issue of the misleadingly named Provincial Engineering Services in the state railways and the Public Works Department. In both these departments, the distinction between Imperial and Provincial Services was to be abolished by merging the two into a single service.[51]

Second, the Commission recommended differing combinations of recruitment in Britain and India for different types of public service. Indian finance and military finance could henceforth be filled entirely by recruitment in India—provided, in the latter department, that 'there are no military considerations to the contrary.' The bulk of recruitment should continue to be made in England for the ICS and Indian Police, 'in which it should be recognised that a preponderating proportion of the officers should be recruited in Europe',[52] although provision was made for the recruitment of a small number of officers in India. (No reason was provided as to why this should be the case—although it probably reflects a policy of retaining responsibility for security in European hands. A similar concern seems to have been behind the old rule, under which recruitment in London for the Indian Police was restricted to European candidates.)[53] In

[48] Sharma, *Indianization of the Civil Services*, Chapters IX and X. For more detail on the arguments of Subba Rao and others in this debate, see 'Minute by Mr. Abdur Rahim' in *Islington Commission Report*, pp. 394-488, here pp. 394-5.
[49] *Islington Commission Report*, p. 2 and p. 7; W.C. Madge identifies himself as an Anglo-Indian in 'Minute by Mr. W.C. Madge'.
[50] *Islington Commission Report*, p. 2.
[51] *Ibid.*, pp. 18-19.
[52] *Islington Commission Report*, p. 61 (paragraph vi).
[53] For the ICS, nine officers annually were to be recruited in India on the basis of a competitive exam but with 'safeguards'. Annexure X: 'Indian and Provincial Civil Services', *Islington Commission Report*, pp. 161-239, here pp. 171-2 (paragraphs 18-20). In the case of the Indian Police, the Commission recommended that the bar on Indians competing in London be removed. Further, an existing provision,

other services, such as those pertaining to Education, Medical, and Public Works, 'there are grounds for policy'—again unspecified—'for continuing to have, in the personnel, an admixture of both western and eastern elements'. Here a mixture of recruitment in Britain and India was to be adopted: proportions were specified for each department, e.g. 50-50 in Public Works.[54] Where the main reason for recruitment in Europe was the lack of technical training facilities in India (e.g. agricultural service, geological survey), such facilities should be built up with the goal of recruiting entirely in India.[55]

Third, the Commission was against the institution of competitive examinations in India, arguing that the education system in the country was not yet sufficiently developed, nor uniformly enough distributed across regions, for examinations to yield the required type and mix of officers. The argument was that competitive examinations were only suitable in England, because of the general educational standard prevailing there. The success of the exams for the Indian civil and medical services (held in London), and of the British civil service exams, was cited in support of this view.[56] While not endorsing new competitive examinations in India, the Islington Commission suggested some measures to improve the nomination process there—and increase the proportion of Asiatics—such as creating selection committees with Indian members, advertising openings systematically, and starting new technical institutions.[57] (It should be noted here that in 1922 an ICS exam was instituted in India, but—primarily because it was held *after* the London exam each year—it remained of limited importance as a source of Indian officers.)[58]

Significantly, although recommendations were made about the place of recruitment, the Islington Commission declined to use the method of race-based quotas, 'mainly because we recognise the tendency of a minimum to become a maximum, and wish to establish nothing which will prevent qualified Indians, where available, from being appointed in any number on

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under which the Governor-General could make some appointments in India from among Domiciled Europeans and Anglo-Indians, should be extended to include 'native' Indians too. Annexure XVI: 'Police Department', *Islington Commission Report*, pp. 297-316, here pp. 298-9.

[54] Quoted text from *Islington Commission Report,* p. 61 (paragraph vi); see also *ibid.*, p. 27 (paragraph 36).

[55] *Islington Commission Report,* p. 61 (paragraph vi); *Ibid.*, p. 22 (paragraph 32).

[56] *Islington Commission Report*, pp. 29-33. In fact, competitive examinations had only accounted for one-third of appointments to the British civil service between 1871 and 1910, the rest being filled through patronage or by candidates with specialised professional training. Rodney Lowe, *The Official History of the British Civil Service: Reforming the Civil Service, Volume 1: The Fulton Years, 1966-81*(Abingdon: Routledge, 2011), p. 21.

[57] *Islington Commission Report*, p. 62 (paragraphs ix and xi); *ibid.*, p. 27 (paragraph 36).

[58] Potter, 'Manpower Shortage', especially p. 51 and p. 55, including Tables 1 and 2.

their merits.'[59] This approach was also taken in some cases—notably for the state railways—by the next important Royal Commission, as discussed below. However, it was not endorsed by Indian opinion, which found the recommendations on Indianisation inadequate, the Allahabad-based *Leader* making the point that the Commission had concentrated on the pay and emoluments of officers to the detriment of the more important issue of Indianisation.[60] Indian politicians and activists, while acknowledging that the recommendations would go some way to ameliorating the position of Indians, were sharply critical of some of the principles underlying the report. Particular exception was taken to the Commission's stand on maintaining in the ICS and Indian Police a 'preponderating proportion of officers … recruited in Europe'. Indian members of the Imperial Legislative Council criticised this stipulation as it applied to the ICS,[61] while H.N. Kunzru of the Servants of India Society saw in it a thinly veiled form of racial discrimination. 'The doctrine it lays down implies that the principle of British sovereignty carries with it the corollary that power must for ever be wielded by men of British birth, and teaches Indians that the maintenance of British rule is incompatible with their highest development.'[62] Kunzru further pointed out that some of the Commission's points regarding the need for Europe-recruited officers were pure assertions rather than arguments, and that the evidence placed before the Commission did not provide any grounds for its stance in these cases.[63]

Another criticism was of the Islington Commission's position on race-based quotas. The Commission had been specifically charged with looking into the prospects of 'non-Europeans'—which it defined as 'Indians and Burmans of unmixed Asiatic descent'[64]— but its recommendations, as we saw, only dealt with place of recruitment (in England or in India). In this they were seen as ducking part of the issue—the low proportion of non-Europeans even among officers recruited in India. One Indian member of the Commission, M.B. Chaubal, argued in a dissenting minute that '[t]he very meagre percentage of the Asiatic Indians in the higher service ought not to be hidden from view by lumping the Anglo-Indians and the Asiatic Indians together, under the plausible excuse of the definition of "statutory natives of India"'.[65]

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[59] *Islington Commission Report*, p. 26.
[60] The reaction of Indian newspapers is described by Shukla, *Indianisation of All-India Services*, pp. 200-3. He refers to the view of the *Leader* on p. 201. See also 'Minute by Mr. M.B. Chaubal'; and Kunzru, *Public Services in India*, esp. p. 175.
[61] Sharma, *Indianization of the Civil Services*, pp. 198-9.
[62] Kunzru, *Public Services in India*, p. 173.
[63] See Kunzru's points on Public Works, Railways and Telegraphs in *ibid.*, pp. 149-51.
[64] *Islington Commission Report*, p. 23.
[65] 'Minute by Mr. M.B. Chaubal', p. 380. See also paragraph 24 in *ibid.*, p. 381.

Some of the recommendations of the Islington Commission were put into practice, most notably in the form of the 1920 creation of an amalgamated Indian Service of Engineers in the Public Works Department and an analogous service for the state railways (which I describe in Chapters 4 and 5). But the rest of the report, especially the parts dealing with percentages to be recruited in India, was soon made redundant when further changes were made in response to political developments occurring during and after World War I.

The 1919 reforms and the Lee Commission (1923-4)

World War I brought the issue of Indian participation in government councils and services to the forefront of policy debates. Historians have identified several factors in this process. First, Indian politicians had cooperated with the war effort, actively campaigning to raise funds and recruit men for the army. The large numbers of Indians who thus fought alongside British and dominion soldiers in Europe and Mesopotamia created a new feeling of confidence among Indians. In these circumstances, Indians were in a position to press for reforms in return. Second, the Allied Powers' rhetoric emphasised that they were on the side of freedom against a belligerent Germany, and invoked the right of peoples to self-determination. The British government could not logically deny that this applied to the Indian people too. Third, there was a temporary unity among Indian politicians as they pressed the case for Indian self-government. In particular, the Congress cooperated with the Muslim League (which had been created a decade earlier, at the time of the Bengal partition) in 1916 to place before the government a joint resolution, asking for a definite statement from the British monarch that 'self-government' in India would be introduced as swiftly as possible. Furthermore, these incremental changes were accompanied by other, more radical developments. Some revolutionaries sought to use violent means to overthrow the colonial government, and repressive laws were enacted. Meanwhile Annie Besant (head of the Theosophical Society in Madras) and Bal Gangadhar Tilak began Irish-inspired Home Rule Leagues demanding immediate self-government as opposed to incremental reforms.[66]

Responding to the demands of the moderate Indian politicians who had supported the war effort, while attempting to weaken the hand of radical nationalists, the government

[66] Stein, *History of India*, Chapter 7; Shukla, *Indianisation of the All-India Services*, pp. 203-6; Metcalf and Metcalf, *Concise History of India*, Chapters 5 and 6; Riddick, *The History of British India: A Chronology*, p. 96; Curtis (ed.), *Papers relating to Dyarchy*, pp. 359-66 (the Congress-League demand on 'self-government' is quoted on pp. 359-60).

proposed a new policy of constitutional reform.[67] On 20 August 1917, in a famous statement in the House of Commons, Edwin Montagu, the Secretary of State for India, announced that the British government's 'policy … is that of the increasing association of Indians in every branch of the administration, and the gradual development of self-governing institutions, with a view to the progressive realisation of responsible government in India as an integral part of the British Empire.'[68] Montagu then proceeded to India at the behest of the Viceroy, Lord Chelmsford, to discuss how this policy might be implemented. After much public debate, the process culminated in the Government of India Act of 1919.[69]

The Montagu–Chelmsford Reforms, as the provisions of the 1919 Act were known, were introduced as a step towards 'responsible government'. A bicameral legislature was created at the centre, with a Legislative Assembly and a Council of State, both of which had a majority of seats reserved for elected members (as against nominated members). In the provinces too the Councils were given an elected majority, and elected members given a small measure of executive power in a system known as 'dyarchy'. Under dyarchy, fields of administration applicable to the provinces were divided into two categories:

1. 'transferred' fields, which were placed under the charge of elected provincial ministers (including Agriculture, Education, PWD (Roads & Buildings)); and
2. 'reserved' fields, which were retained under the provincial Governor and his Executive Council, representing the Crown (e.g. PWD (Irrigation), Law and Order, Revenue).

In summary, 'responsible [to the people] government' was introduced on a small scale, with the paternalistic promise that the situation would be reviewed in ten years' time and the role of ministers expanded if they were deemed to have administered their areas capably in the intervening period. Important caveats were built into the reforms too: the Viceroy had a power of veto over the laws drafted by groups with a majority in the legislatures.[70]

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[67] Burton Stein writes that the new policies were 'intended to broaden the strata of Indians willing to collaborate with imperial authority.' Stein, *History of India*, p. 293.

[68] 'India. Government Policy', HC Debate 20.8.1917, Hansard (Fifth Series, Vol. 97), cc. 1695-7, here c. 1695. Via ProQuest, House of Commons Parliamentary Papers Online.

[69] *Ibid.*, c. 1696; Curtis (ed.), *Papers relating to Dyarchy*, esp. 'Introduction'.

[70] Stein, *History of India*, Chapter 7, esp. p. 293; *Lee Commission Report*, p. 7; Curtis (ed.), *Papers relating to Dyarchy*; *East India (Constitutional Reforms). Report on Indian Constitutional Reforms* (Cd. 9109, London: HMSO, 1918), p. 213 (paragraph 263). The last of these sources is hereinafter cited as *Montagu–Chelmsford Report*. See also *India Office List* for 1929, pp. 7-12 and p. 43, for an example of the structure of government at the central and provincial levels after the Montagu-Chelmsford Reforms.

The import of the new policy for the services was two-fold. First, Montagu's reference to 'the increasing association of Indians in every branch of the administration' was naturally understood by Indian leaders as a commitment to further Indianise the services. Second, the introduction of dyarchy made the position of the All-India Services ambiguous. Indian politicians felt that the presence of officers recruited by, and responsible to, the Secretary of State in services that were operating in transferred fields necessarily curtailed the autonomy of elected ministers in the provinces.[71]

A third factor also came into play: the Indian public services were becoming less attractive both to British officers already in India and to potential applicants in Britain. They were apprehensive about their status under the changing political system. They were also wary of the political disquiet that was growing in India,[72] mainly as a reaction to draconian anti-sedition measures introduced towards the end of the war, such as the infamous Rowlatt Act of March 1919, which perpetuated the government's wartime extraordinary powers by allowing for detention without trial for the next three years. After the massacre of Amritsar the following month, when General Dyer had ordered soldiers to open fire on hundreds of demonstrators in an enclosed park called Jallianwala Bagh, 'the reforms had become a poisoned chalice'.[73] Meanwhile Gandhi had begun the non-cooperation movement in 1920.[74] In addition to these developments, the cost of living in India had gone up in the aftermath of the war. A particular grievance was that as the rupee's value relative to the pound had fallen, British officers' expenses incurred in importing British goods and educating their children in Britain had in effect risen.[75]

This three-pronged problem with regard to the services—the implementation of Indianisation, the status of the all-India services under dyarchy, and the Secretary of State's need to attract British applicants—led in 1923 to the institution of a fresh Commission: the Royal Commission on the Superior Civil Services in India (Lee Commission), with five British and four Indian members.[76]

The Lee Commission recommended the provincialisation of the All-India Services in fields that had been transferred to elected ministers under the Montagu–Chelmsford reforms

[71] *Lee Commission Report*, pp. 5-6.
[72] *Ibid.*, p. 6.
[73] Riddick, *History of British India*, pp. 102-3; quoted text from Metcalf and Metcalf, *Concise History of India*, p. 165.
[74] Stein, *History of India*, Chapter 7.
[75] *Lee Commission Report*, p. 5 and pp. 24-5. According to David Potter, writing on the ICS in particular, potential recruits were discouraged more by unattractive pay and service conditions than by the political situation. Potter, 'Manpower Shortage', p. 53.
[76] *Lee Commission Report*, pp. 5-6; p. ii for composition of Commission.

(e.g. Roads & Buildings). This meant that all future recruitment for posts in transferred departments would be made by the concerned provincial ministers—thus addressing the complaint that officers responsible to London could not logically serve ministers responsible to Indian voters.[77] However, existing All-India officers would not be removed from their provincial posts. They were given the option to stay on under their old terms of employment (i.e. 'retain their All-India status'), to relinquish their old terms and sign fresh contracts with the provincial government they were serving, or to retire early with 'proportionate pension'.[78] This change also implied Indianisation in the transferred fields, as officers recruited in the provinces would most likely be Indians.[79]

As for Indianisation of the services in fields reserved to the control of provincial Governors (e.g. Revenue, Law and Order), the Commission introduced quotas for recruitment for Europeans and Indians (and in some cases by place of recruitment), superseding the recommendations of the Islington Commission. For instance, in the Indian Civil Service, 40 per cent of new recruits were to be Europeans, 40 per cent Indians, and the remaining vacancies to be filled by promoting Indians from the Provincial Civil Service—a proportion calculated to bring about within 15 years an overall 50-50 composition of Europeans and Indians in the ICS.[80] For the Indian Police the time allowed for the achievement of a 50-50 composition was 25 years.[81] In the case of the Irrigation branch of the PWD (recruitment for which remained in the hands of the Secretary of State under dyarchy), no such target was set, but the Commission recommended that fresh recruitment be carried out in the ratio of 40-40-20 (European/ Indian/ Indians promoted from provincial services).[82] For the Superior Services of the state-run railways (which formed Central Services), the Lee Commission recommended a mix of recruitment in India and Britain. The prescribed ratio here was 3:1, i.e. 75 per cent of vacancies were to be filled by officers recruited in India. However, the government was allowed some latitude: the 3:1 ratio was to be implemented not forthwith but 'so soon as practicable'.[83] (The official response to the recommendations on railways, and the reasons behind it, are analysed in Chapter 5.)

[77] *Ibid.*, p. 62 (paragraphs i, ii and iii); Shukla, *Indianisation of All-India Services*, p. 255.
[78] *Ibid.*, p. 70 (paragraph xliii).
[79] Shukla, *Indianisation of All-India Services*, p. 255.
[80] *Lee Commission Report*, p. 65 (paragraph xiii). The report does not give the percentage of Indians in the ICS as of 1924.
[81] *Ibid.*, p. 65 (paragraph xiv).
[82] *Ibid.*, p. 65 (paragraph xvi).
[83] *Ibid.*, p. 66 (paragraph xvii-d).

Finally, to improve the financial situation of British officers, the Commission increased their overseas pay. Officers of 'non-Asiatic domicile' were also permitted, once they had completed four years of service, to remit their salaries (earned in rupees) to England at a fixed exchange rate of 2*s.* to the rupee, which was more favourable than the actual rate.[84]

As J.D. Shukla has shown, Indian opinion, as represented in the country's newspapers, was dissatisfied with the recommendations. It found the proposed rate of Indianisation too conservative, and that the measures regarding the emoluments of European officers were a drain on national resources.[85] In the Legislative Assembly in Delhi, the government's resolution to adopt the Lee recommendations was defeated, Motilal Nehru arguing instead for a complete cessation of recruitment in England. Nevertheless, the presentation of the Report to the Assembly was a mere courtesy—after all it was concerned with officers recruited by the Secretary of State. The Assembly was overruled by the British Parliament, and the Government of India (Civil Services) Bill became law in January 1926.[86]

Further provincialisation: the Government of India Act, 1935

The 1919 Government of India Act had provided for a review of its working at the end of ten years. The Simon Commission was appointed in 1927 to carry out this review, but its all-British composition angered Indian politicians. Eventually, Indian representatives were invited to a series of Round Table Conferences in London in the early 1930s to discuss further constitutional reform, culminating in the Government of India Act of 1935.[87]

Under the 1935 Act, provincial autonomy was introduced in all fields except those of strategic importance (e.g. Defence, External Affairs), which the Viceroy retained direct control of. At the centre, a federal council of representatives from the provinces and princely states was to be established; but the federation was to come into being only when fifty per cent of the

[84] *Ibid.*, p. 67 (paragraphs xix and xx), and pp. 24-5.
[85] Shukla, *Indianisation of All-India Services*, p. 259. Some Indians called the additional cost of the new measures 'Lee Loot'. Potter, 'Manpower Shortage', p. 54.
[86] Shukla, *Indianisation of All-India Services*, pp. 260-1; *Statement Exhibiting the Moral and Material Progress of India* for 1925-6, p. 4. See also the discussion of the Lee Commission's recommendations in the House of Lords. 'Government of India (Civil Services) Bill', House of Lords Debate, vol. 60, cc. 915-928 (Hansard). Via http://hansard.millbanksystems.com/ .
[87] Metcalf and Metcalf, *Concise History of India*, Chapter 6; R.J. Moore, 'The Problem of Freedom with Unity: London's India Policy, 1917-47', in D.A. Low (ed.), *Congress and the Raj: Facets of the Indian Struggle 1917-47*, 2nd edn (New Delhi: Oxford University Press, 2004), pp. 375-403; Andrew Muldoon, *Empire, Politics and the Creation of the 1935 India Act: Last Act of the Raj* (Abingdon, Oxon: Ashgate, 2009), Chapter 2; Riddick, *History of British India*, pp. 106-110; Stein, *History of India*, Chapter 8.

princes had accepted it, a condition which was never fulfilled.[88] Historians have argued that the 1935 Act, drafted and passed under a National government in Britain in which Conservatives had a powerful say, was designed to limit the influence of the Congress, and to retain ultimate control of India in British hands. Through the federal government at the centre—where a large proportion of seats would be reserved for Muslims and for the princely states—the new constitution would confine Congress influence to the provinces.[89] As Lord Linlithgow (Chairman of the 1935 Joint Parliamentary Committee; Viceroy, 1936-43) wrote privately some years later, the 1935 constitution was designed to '[maintain] British influence in India. It is no part of our policy, I take it, to expedite in India constitutional changes for their own sake, or gratuitously to hurry the handing over of the controls to Indian hands at any pace faster than that which we regard as best calculated, on a long view, to hold India to the Empire.'[90]

While the federation did not materialise, provincial autonomy came into effect. Elections were held in 1937 with an enlarged electorate of around 30 million voters; the Congress won around fifty per cent of all seats and assumed power in several provinces.[91] The All-India Services which had not already been provincialised were now placed directly under the elected ministers, although British parliamentarians resisted the move (primarily as it meant the handing over of more responsibilities to Indian officers).[92] Exceptions were made, however, for the ICS, the civil branch of the Indian Medical Service, and the Indian Police, which remained in the hands of the Secretary of State. However, all existing All-India officers continued on their old terms, so that the old cadres were not abolished but allowed to dwindle as their members retired.[93] The 1935 Act also made several provisions to protect them from the authority of elected Indian ministers.[94] These measures aimed at strengthening the position of officers recruited in England are best understood in the light of David Potter's argument that the British and colonial Indian governments, unwilling to entrust Indian officers with what they saw as crucial responsibilities, relied heavily on the continuing availability of British officers in

[88] Stein, *History of India*, p. 326; Metcalf and Metcalf, *Concise History of India*, pp. 192-3; Moore, 'The Problem of Freedom with Unity'.
[89] Moore, 'The Problem of Freedom with Unity'; Metcalf and Metcalf, *Concise History of India*, Chapter 6.
[90] Quoted in Moore, 'The Problem of Freedom with Unity', p. 379.
[91] Metcalf and Metcalf, *Concise History of India*, p. 193.
[92] I analyse the arguments advanced for and against the measure in the case of the Irrigation Service, in Chapter 4 below.
[93] *Government of India Act 1935* (26. Geo. 5. Ch. 2), paragraph 244 (pp. 148-9); Shukla, *Indianisation of All-India Services*, p. 335. Shukla mentions the Indian Agricultural Service, Indian Service of Engineers and Indian Educational Service among the services fully provincialised at this stage.
[94] See the critique by K.T. Shah, *Public Services in India (Congress Golden Jubilee Brochure—7)* (Allahabad: All India Congress Committee, 1935).

order to retain control of India.[95] In Chapters 4 and 5 of this thesis, I extend Potter's line of argument to show the particular nature of such concerns (and the reasons behind them) as expressed by officials with regard to public works and railway engineers.

As a result of the negotiated process of Indianisation, the major services arrived approximately at a 50-50 composition of Indians and Europeans by around 1940. For instance, the ICS had 597 Indians and 588 Europeans as of 1 January 1940,[96] while the railways' Superior Services were 50 per cent Indian by 1939.[97]

Industrialisation: Interwar policy and the growth of large-scale industry

Just as World War I and the ensuing political changes had important consequences for government services, they also influenced the performance of existing industries, and the growth of new ones. The war provided a boost to industrial production, as imports fell and the demand for Indian goods increased.[98] More importantly, the war marks the point when Britain's economic policies in India underwent an important shift. In the nineteenth century, the colonial government had declined to play an active role in the promotion of industry in India or to afford it any protection, thereby safeguarding the interests of British industries that exported their products to India. But during the Great War, when resources, technical personnel and technical equipment were drained out of India, the dependent position of the Indian economy was exposed. The government saw that the lack of industrial capability had adverse implications for India's security, for its ability to contribute to the war effort in Europe (except in the form of soldiers for the army), and for the stability of the imperial economic system in the face of foreign competition. In May 1916, the Government of India's Department of Commerce and Industry issued a resolution declaring that 'the time has come when the question of the expansion and development of Indian manufactures and industries should be taken up in a more comprehensive manner than has hitherto been attempted.' The resolution announced the appointment of what became known as the Indian Industrial Commission (IIC) to investigate the situation and suggest ways to promote industry in India.[99]

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[95] Potter, 'Manpower Shortage'.
[96] Beaglehole, 'From Rulers to Servants', p. 241.
[97] Ian J. Kerr, *Engines of Change: The Railroads That Made India* (Westport, CT and London: Praeger, 2007), p. 119. Kerr appears to be referring here to state-run and company-run railways together. See also Chapter 5 of this thesis for a detailed analysis of Indianisation in the railways, especially in the interwar period.
[98] T. Roy, *The Economic History of India*, p. 228-9; R.K. Ray, *Industrialization in India*, p. 4.
[99] Headrick, *Tentacles of Progress*, p. 338; Basu, 'Technical Education', pp. 54-5; 'The Indian Industrial Commission: its report summarised', in *East India (Industrial Commission): Report of the Indian*

The IIC, presided over by Sir Thomas Holland, a former Director of the Geological Survey of India,[100] made a number of important recommendations in the report it published in 1918. Among other measures, the Commission suggested that provincial governments should provide technical assistance to select industries and support private industrialists in providing artisanal/industrial education. Industrial banks should be created to make capital available to industrialists, and in some cases the central government might also assist industries financially. In order to discharge all these functions, Departments of Industries should be created in every province. Further, the IIC recommended that an Imperial Department of Industries be created at the centre, and an Imperial Industrial Service be constituted to staff the departments of industries throughout India. The Commission also stated that materials and machinery required for government and railways should, whenever possible, be purchased in India. Provincial Stores officers could also consider buying supplies direct from other provinces.[101] This last constituted a significant change from the government's existing policy, under which stores were purchased exclusively in London through a Stores Purchase Department. Although the policy of purchasing in India was inconsistently applied over the following decades, the government became one of the most important customers of Indian industries.[102] After 1919, the responsibility for Industries devolved upon provincial ministers, but many of the IIC's recommendations applicable to the provinces remained relevant. Bengal, for instance, created a provincial Department of Industries in 1920.[103] Although the IIC's vision could not apply in its entirety to post-1919 India, the main principles underlying its report made the Commission an important step in the evolution of the government's industrial policy. As Shiv Visvanathan has argued, the IIC's report formed 'a complete grid on which all the later debates on science and technology may be plotted.'[104]

A related and equally important factor determining the fate of India's industries was the changing fiscal relationship between India and Britain. The Montagu–Chelmsford Report

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Industrial Commission, 1916-18 (Cmd. 51, London: HMSO, 1919), pp. 1-4. The quote is from the Government of India Resolution dated 19 May 1916, printed as Appendix A-1 in the last named source (Cmd. 51, 1919), pp. 301-2, here p. 301.

[100] L.L. Fermor, 'Thomas Henry Holland. 1868-1947', *Obituary Notices of Fellows of the Royal Society*, Vol. 6, No. 17 (Nov., 1948), pp. 83-114, here p. 86; Roy M. MacLeod, 'Holland, Sir Thomas Henry (1868–1947)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 (http://www.oxforddnb.com/view/article/33945, accessed 11 June 2012).

[101] Indian Industrial Commission, 1916-18, *Report* (Calcutta: Superintendent Government Printing, 1918), Chapter XXIV, 'Summary of Recommendations'. This source is hereinafter cited as *IIC Report.*

[102] Rothermund, *An Economic History of India*, pp. 116-7.

[103] A.Z.M. Iftikhar-ul-Awwal, *The Industrial Development of Bengal: 1900-1939* (Delhi: Vikas Publishing House, 1982), p. 59.

[104] Shiv Visvanathan, *Organizing for Science: The Making of an Industrial Research Laboratory* (Delhi: Oxford University Press, 1985), p. 42.

(1918) approved economic protection in principle, and the Indian Fiscal Commission (1921-2) sanctioned the raising of protective tariffs against imports, although with some caveats. To reduce the burden on the Indian consumer, 'discrimination' was to 'be exercised in the selection of industries for protection', which meant that only those industries would be protected which enjoyed 'natural advantages' in terms of available raw materials etc., which would not be able to develop in the absence of protection, and which showed the potential to compete in time with foreign manufactures in an open market. To decide which industries should be granted protection, an Indian Tariff Board was to be set up.[105]

The policy of protection was clearly related to the growth of several industries in the 1920s and '30s. In this period 51 enquiries were made by the Tariff Board, and 11 industries were granted protection, including iron and steel, cotton textiles, paper, sugar and heavy chemicals. These industries grew, mainly by producing substitutes for imported products.[106] With the help of protection, many industries also rode out the Great Depression successfully. While enterprises mainly exporting their products (e.g. jute manufacturers) experienced difficulties,[107] conditions during the Depression were actually beneficial to the steel industry (based on import substitution), as any loss in demand had to be borne by imports, on which tariffs were payable.[108]

There was also a change in the ownership pattern of industries in the interwar period. The older European managing agencies receded in importance—their business was founded upon exports, and therefore did not benefit from protection. On the other hand, foreign manufacturers saw the opportunity to invest in industry within India, with a view to capturing the (protected) domestic market. Thus British, European and American firms set up subsidiaries in India (referred to as 'multinationals') in the interwar period, e.g. Imperial Chemical Industries (ICI), Lever Brothers, and the Swedish Match Company (Wimco). But the most important development was the rise of Indian business houses, which increasingly invested in large-scale industries. These had their origins in Indian communities which by tradition had been associated with trade. Most of them had made vast profits through speculation during World War I, enabling them to enter the industrial sector in the interwar period. In some cases these business families started out by manufacturing products covered by the tariffs, such as sugar and paper, then reinvested their profits in more specialised industries such as shipping and sewing

[105] 'Summary of Recommendations', *Report of the Indian Fiscal Commission, 1921-22* (Simla: Superintendent Government Central Press, 1922), pp. xv-xvii (includes quoted text); *ibid.*, Chapter 1.
[106] T. Roy, *The Economic History of India*, pp. 229-30; Dietmar Rothermund, *An Economic History of India: From Pre-Colonial Times to 1991* (2nd edition, London: Routledge, 1993), p. 110.
[107] T. Roy, *The Economic History of India*, p. 231.
[108] R.K. Ray, *Industrialization in India*, p. 77.

machines. Indian businessmen also developed contacts with the Indian National Congress, and grew increasingly aware of their collective interests. This led to the formation (in 1927) of the Federation of Indian Chambers of Commerce and Industry (FICCI) to counter the Associated Chambers of Commerce, which mainly represented the interests of British firms in India. The importance of Indian-owned companies increased. They were responsible for the lion's share of fresh private investment in industry in our period, particularly in the 1930s. By 1944 these companies also accounted for over 80 percent of workers employed in large-scale industry in the country.[109] R.K. Ray has advanced two explanations for this Indianisation of capital investment in industry: first, some Indian businesses were bold in their investments as they were guided by a spirit of economic nationalism; and second, foreign businesses which repatriated their profits to Europe naturally had less capital available to invest in further projects in India.[110]

Despite the existence of several macro-studies (such as the ones referred to in this chapter) of these developments by economic historians, the role of technical experts in the industrialisation process has received very little attention in the literature. Technology/ technological know-how is seen as one of many factors in the development of industries, but is usually treated as a disembodied concept;[111] the literature presents no detailed descriptions or systematic data regarding industrial engineers and technicians, their numbers, their qualifications, or their nationalities. Nevertheless, one significant theme can be discerned from remarks made in passing in the literature. This relates to the growing Indian-owned industries in our period. Most of them employed foreign technical experts and machinery in their early years, whether in the case of Sarupchand Hukumchand's engineering works, of the Bombay textile industries that depended on plant and mechanical engineers from Lancashire, or of the Indian shipping companies that could not initially obtain Indian marine engineers. It was particularly true of the specialised industries started in the 1940s, such as the automobile manufacturing concerns of the Birla and Walchand groups. The literature notes also that efforts were made to train Indians to replace the foreign engineers in these industries.[112] Yet how industrial

[109] Dietmar Rothermund, *An Economic History of India*, p. 92; R.K. Ray, *Industrialization in India*, p. 5, pp. 271-2, p. 276; B.R.Tomlinson, *The Economy of Modern India, 1860-1970* (Cambridge: Cambridge University Press, 1996 [1993]) (*The New Cambridge History of India*, III, 3), pp. 142-3 and p. 145.
[110] R.K. Ray, *Industrialization in India*, pp. 244-5.
[111] B.R. Tomlinson remarked as early as 1981 that 'scholars studying the development of Indian industry in the first half of the twentieth century have paid too much attention to analyses based on generalized concepts of supply and demand constraints, technological innovation and adaptation, and factor endowments.' B.R. Tomlinson, 'Colonial Firms and the Decline of Colonialism in Eastern India 1914-47', *Modern Asian Studies*, Vol. 15, No. 3 (1981), pp. 455-86, here p. 485.
[112] Iftikhar-ul-Awwal, *Industrial Development of Bengal*, p. 150; R.K. Ray, *Industrialization in India*, p. 62, p. 105, pp. 177-8.

enterprises went about this Indianisation of their engineering staff is a question that has not been explored at any length. It is this question, along with the more general one of assessing industrial engineers' contribution to the growth of large-scale industry, that I address in detail in my study of the Tata Iron and Steel Company in Chapter 6.

Conclusions

This chapter has described the key events and sentiments that influenced the Indianisation of the public services in India, 1900-47. Three interlinked factors were involved. The first of these was the British policy of maintaining a sizeable proportion of British officers in the most responsible positions within the public services. The second was the growth of the nationalist movement, in both its moderate and radical forms. This led to constitutional reforms that, in amplifying the political voice of Indians in the legislative councils, provided an effective forum in which to mount demands for the Indianisation of the services. The third factor was that in the changing political and economic conditions in interwar India, British aspirants became less enamoured of the Indian services. The history of the Islington and Lee Commissions should be understood in the light of the state's attempt to balance these three factors. Time and again, concessions to Indian aspirations were coupled with measures designed to make the services more attractive to British recruits. At the same time change was impeded by the colonial government's reluctance to allow rapid Indianisation. The result was that Indianisation proceeded in small increments until the end of the 1930s, when the Indian share of some of the major services crossed 50 per cent.

The existing historiography has sought to understand this outline of events mainly in relation to the ICS. It tells us little about the effect of the Indianisation process on engineers and other technical experts employed by the government in our period. I will address this omission by examining the structure and composition of two important categories of engineering service—public works and railways—that were deeply affected by the negotiated processes of Indianisation and constitutional reform. In Chapters 4 and 5 I study the training, career paths and work culture of these engineers, and how they were influenced by changes in colonial governance. In doing so, I highlight the varying manifestations of Indianisation in different sectors employing engineers; and enhance existing explanations for this process by revealing the influence of prevailing ideas about race and technical expertise.

Going beyond the Indianisation of the public services, this thesis also studies the analogous processes among engineers in industry, and in the Indian engineering profession at

large. In particular, I focus on the experts of the Tata Iron and Steel Company (TISCO; one of the most important heavy industries in interwar India) as a way to illustrate the central role played by engineers in Indian industrialisation. As in the case of government engineers, I explore the backgrounds, training and work culture of these industrial engineers; demonstrate the role of foreign engineers and Indians trained abroad; and examine the process by which TISCO Indianised its highly specialised staff of technical experts (Chapter 6). Through an analysis of professional institutions, I also chart the relationship in the converse direction, showing how industrialisation impacted the composition and goals of the engineering profession as a whole (Chapter 3). It is impossible adequately to understand the interwar industrialisation of India without understanding the history of industrial engineers, or the engineering profession without paying attention to the growing need for industrial engineers in our period.

CHAPTER 3

Professional Institutions and the Growth of an Indian Identity among Engineers

Introduction

This chapter studies the development of the Indian engineering profession as a whole in the period 1900-47. Historians have not focused on engineers in India as a group in this period, although there have been studies dealing with other STM communities, or with specific types of engineer in an earlier period. These include David Arnold's exploration of the career trajectories of scientists (European and Indian) and the formation of an 'Indian scientific community'; Ian Derbyshire's study of the use of 'western' technology in constructing India's railways, which refers to the community of expatriate engineers in the long nineteenth century; Mark Harrison's portrait of colonial medical officers and their quest for protection through medical registration; and Roger Jeffery's studies of the medical profession before and after Indian Independence.[1]

One way of gaining historical insights into the collective development, aspirations and identities of engineers is through the study of professional institutions—an approach that historians have used to study engineers in countries such as Britain, Germany, Canada and the USA.[2] Here I apply this approach to the engineering profession in India. As I will show, engineers in India organised themselves into groups to discuss technical aspects of their work. The nature and goals of their activities were influenced by various parameters including location, type of employer and branch of engineering. They joined professional societies based in London, set up new ones in India that competed with each other, and used these institutions

[1] David Arnold, *Science, Technology and Medicine in Colonial India (The New Cambridge History of India* Vol. III.5*)* (Cambridge: Cambridge University Press, 2000), Chapter 5; Ian Derbyshire, 'The Building of India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995), pp. 177-215; Mark Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine 1859-1914* (Cambridge, New York and Melbourne: Cambridge University Press, 1994), Chapter 1; Roger Jeffery, 'Recognizing India's Doctors: The Institutionalization of Medical Dependency, 1918-39', *Modern Asian Studies*, Vol. 13, No. 2 (1979), pp. 301-326; Roger Jeffery, 'Allopathic Medicine in India: A Case of Deprofessionalisation?', *Economic and Political Weekly*, Vol. 13, No. 3 (21 January 1978), pp. 101-103 + 105-113.

[2] R.A. Buchanan, *The engineers: a history of the engineering profession in Britain, 1750-1914* (London: Jessica Kingsley, 1989); J. Rodney Millard, *The Master Spirit of the Age: Canadian Engineers and the Politics of Professionalism* (Toronto: University of Toronto Press, 1988); Edwin T. Layton, Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Baltimore: Johns Hopkins University Press, 1986); Kees Gispen, *New Profession, Old Order: Engineers and German society, 1815-1914* (Cambridge: Cambridge University Press, 1989).

as a platform to define a pre-eminent role for themselves in the development of the Indian economy.

In the first part of this chapter, I demonstrate the importance of the London-based Institutions of Civil/ Mechanical/ Electrical Engineers for the predominantly expatriate engineers working in India in the nineteenth and early twentieth centuries. I then proceed to examine the history of the Institution of Engineers (India) (or IEI), the first all-India professional institution for engineers. Established in Calcutta in 1920, the IEI aimed to unify engineers of all types (civil, mechanical, and electrical; government and industrial) under one umbrella. Its goals also included the Indianisation of the profession and the promotion of industrial development. Drawing on a range of sources including institutional membership data, journals, annual reports and presidential addresses; government reports; and memoirs of practising engineers, I trace the circumstances leading to the IEI's founding. I then analyse its subsequent growth and development in the face of opposition from competing societies with different, more exclusive visions for the engineering profession. In particular, I argue that the IEI's growth to prominence marked the beginnings of a specifically Indian identity in the engineering profession, which had previously been oriented towards the imperial metropolis.

Thus this chapter, through an analysis of the membership patterns, functions, activities and agendas of the London institutions, local groupings in India, and the Institution of Engineers (India), charts and accounts for fundamental changes in the composition, priorities and identity of the engineering profession in India over the first half of the twentieth century.

Expatriate engineers and metropolitan institutions, 1858-1914

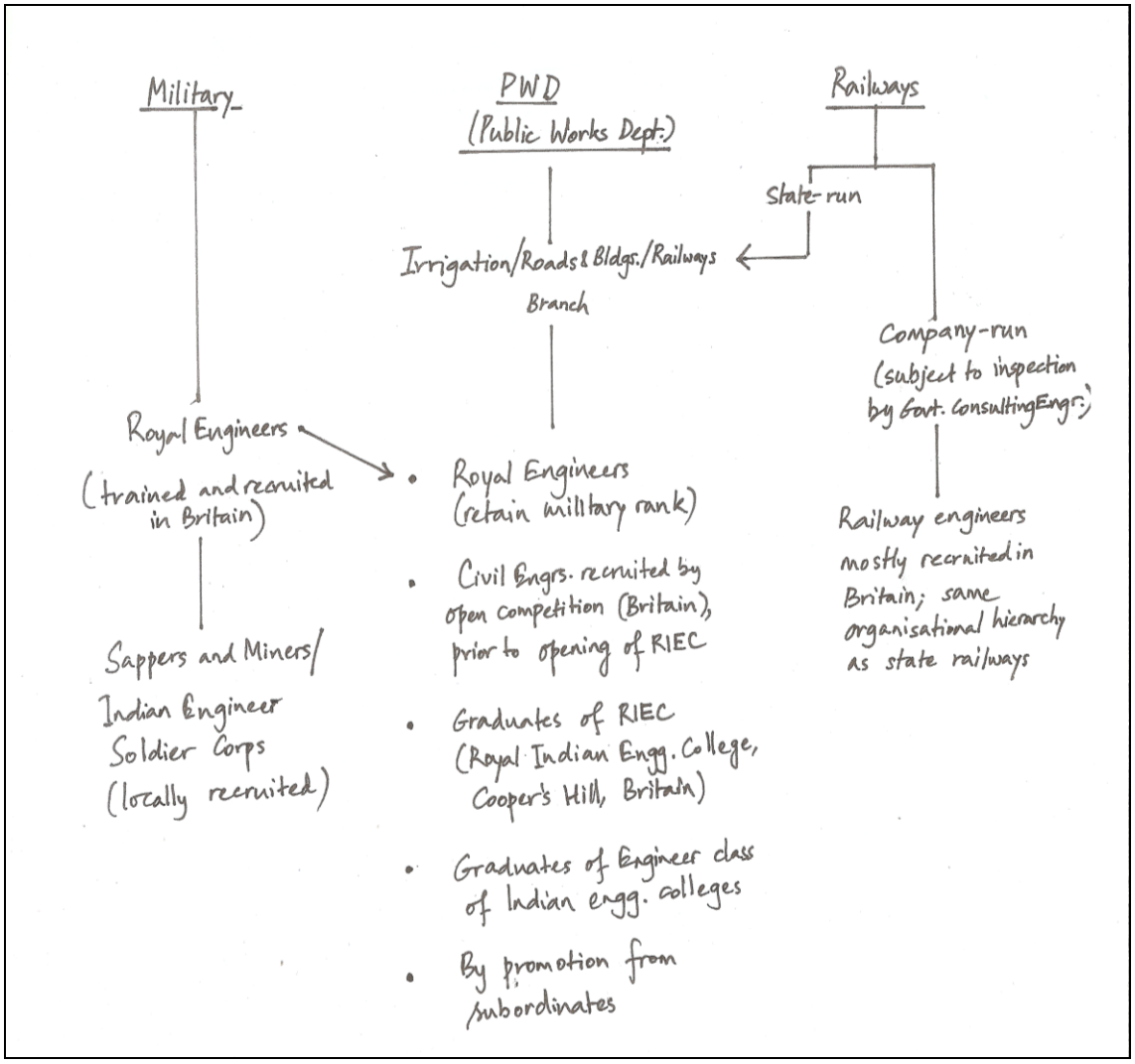
In the nineteenth and early twentieth centuries, the engineering profession in India was dominated by expatriate British engineers employed in public works, the military, and railways (some run by companies, others by the state).[3] Large-scale private industry—and the engineers associated with it—played a minor role in the Indian economy.[4] Thus the main employers of engineers, with the exception of the company-run railways, were direct or indirect organs of the

[3] Until 1905, the state-run railways formed a branch of the PWD; in that year a Railway Board was formed to govern all railways, and was itself responsible to a member of the Governor-General's Executive Council. Ian J. Kerr, *Engines of Change: The Railroads That Made India* (Westport, CT and London: Praeger, 2007), p. 25 and pp. 75-9; G. Huddleston, *History of the East Indian Railway* (Calcutta: Thacker, Spink and Co, 1906), Chapter 1; *East India (Railway Committee, 1920-21). Report of the Committee appointed by the Secretary of State for India to enquire into the administration and working of Indian Railways* (Cmd. 1512, London: HMSO, 1921), Chapter IV, pp. 36-7. The last of these sources is hereinafter cited as *Acworth Committee Report*.

[4] Considering industrial income alone in 1900, large-scale industries' contribution to it was only 15 per cent. Tirthankar Roy, *The Economic History of India 1857-1947*, 2nd edn (New Delhi: Oxford University Press, 2006), p. 224.

colonial state, interlinked in function, personnel and organisational structure. They recruited primarily in Britain, accounting for the largely British composition of the profession (Figure 3.1).

Figure 3.1: *Major employers of engineers in India, c. 1850-1905.*[5]



[5] This diagram is constructed on the basis of various accounts, especially Brendan P. Cuddy, 'The Royal Indian Engineering College, Cooper's Hill, (1871-1906): A case study of State involvement in professional civil engineering education' (PhD thesis, London University, 1980); C.D. Maclean (ed.), *Manual of the Administration of the Madras Presidency: In Illustration of the Records of Government & the Yearly Administration Reports* (reprint, 3 vols., New Delhi: Asian Educational Services, 1987 [1885-93]), vol. 1, especially p. 368; Ian J. Kerr, *Engines of Change: The Railroads That Made India* (Westport, Connecticut and London: Praeger, 2007); S.C. Fenwick, 'Corps History – Part 10: Indian Sappers (1740-1947)', website of the Royal Engineers Museum, Kent (http://www.remuseum.org.uk/corpshistory/rem_corps_part10.htm, last accessed 4 June 2008) [the source cited for the article by the website is G. Napier, *Follow the Sapper: an illustrated history of the Corps of Royal Engineers* (Chatham: Institution of Royal Engineers, 2005)].

As the numbers of British engineers in India grew,[6] some began to meet at local mechanics' institutes to discuss their work experiences and organise lectures on topics of common interest. These mechanics' institutes appear to have been modelled on the contemporary British ones.[7] An example is the Sassoon Mechanics' Institute (est. 1863), which grew out of an association of mechanics from the Royal Mint and Government Dockyard of Bombay, with a benefaction from the banker David Sassoon of that city.[8] Mechanics' institutes, however, were not professional institutions, and no large-scale society of engineers was established in India in the nineteenth century. Instead, many engineers became members of the professional institutions then gaining ground in Britain.[9] Prominent among these were the London-based trio of the Institution of Civil Engineers (ICE, est. 1818), the Institution of Mechanical Engineers (IMechE, est. 1847) and the Institution of Electrical Engineers (IEE; founded in 1871 as the Society of Telegraph Engineers).[10]

The three London institutions were similar in structure and function. Their primary aim was to enable practising engineers to discuss papers on matters of common technical interest. They also performed what Angus Buchanan has called the 'informal licensing function', by obtaining Royal Charters or legal incorporation. Although engineers did not legally require a licence to operate, corporate status indicated that the state endorsed an institution, and thereby its members.[11] To ensure that membership was equated with high professional standards, the institutions established strict requirements—including practical experience and entrance examinations—for aspiring members. Buchanan writes that they also probably performed a regulatory function by '[acting] as a constructive restraint on professional irregularities' and a business function by matching projects to practitioners, 'making expertise available where it was needed.'[12]

The ICE, IMechE and IEE were international in scope. Beyond Britain, they had members in India, in other parts of the British Empire, and sometimes outside it, e.g. in Japan and China.[13] These expatriate engineers considered themselves part of an imperial profession with its base in Britain. They often sent accounts of their work to the London institutions, and

[6] There were 518 PWD engineers in India in the year 1861. Cuddy, 'Royal Indian Engineering College', p. 62 (Table VIII).
[7] Derbyshire, 'The Building of India's Railways', p. 182.
[8] See 'David Sassoon Library and Reading Room: History', http://www.davidsassoonlibrary.com/history.html (accessed 2 July 2012).
[9] Derbyshire, 'The Building of India's Railways', pp. 182-3.
[10] On the origins of the London institutions, see R.A. Buchanan, 'Institutional Proliferation in the British Engineering Profession, 1847-1914', *The Economic History Review*, New Series, Vol. 38, No. 1 (February 1985), pp. 42-60.
[11] Buchanan, 'Institutional Proliferation'. The quoted phrase is from p. 59.
[12] Buchanan, 'Institutional Proliferation'. Quoted text from p. 57.
[13] (Topographical) lists of members of the three institutions, various years.

sometimes attended meetings when they went home on leave. Nineteenth-century issues of the *Minutes of the Proceedings of the Institution of Civil Engineers* contain several instances of papers on engineering projects in India, Egypt, Australia and South Africa.[14] Members received comments and questions in person from colleagues in Britain when the paper was read, and by correspondence from colleagues elsewhere. This enabled the comparison of notes on techniques adopted in different parts of the world.[15] Over time, the process of communication between colonial members and the metropolitan Councils was systematised. Provision was made for 'colonial representatives' on the ICE's Council—in India's case, starting from 1898.[16] The ICE also set up Advisory Committees in South Africa and several Australian provinces (at various times between 1890 and 1907), in New Zealand (1906), in Canada (1911) and in India (1912).[17] The function of these committees appears to have been to advise the Council in London on matters such as admission of members in the concerned overseas location, and their transfer to higher grades of membership.[18] In 1915, the IMechE followed suit and initiated the process of setting up Advisory Committees in India and South Africa.[19]

The India-based membership of the London institutions reflected the predominantly British composition of the engineering community. In 1901, Europeans formed approximately 94 per cent of ICE members residing in India. The corresponding number for the IMechE was also 94 per cent (in 1901), and for the IEE 87 per cent (in 1902). The dominant institution, numerically, was the ICE, which in 1901 had 538 members resident in India, while the IMechE had 124. The corresponding figure for the IEE was 99 members in 1902.[20] The comparatively high numbers for the ICE are a reflection of the overwhelming importance of civil engineering over other branches in India at this time, when the construction of public works and railway lines constituted the bulk of engineering activity—mechanised industries, with the exception of

[14] Derbyshire, 'The Building of India's Railways', p. 178, p. 183 and endnote 20 on p. 206; titles of papers presented on projects in various countries can be seen in the *Minutes of the Proceedings of the Institution of Civil Engineers* of various years (via www.icevirtuallibrary.com).
[15] See for example: Bradford Leslie, 'The Erection of the "Jubilee" Bridge carrying the East Indian Railway across the River Hooghly at Hooghly', *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol. 92, Issue 1888, pp. 73-96; also the discussion (*Ibid.*, pp. 97-128) and correspondence on the paper (*Ibid.*, pp. 129-141). See particularly the contributions of J.H. Cunningham, R.E. Johnston and Leslie himself in reply, in the correspondence.
[16] Memorandum on 'Election of Colonial Representatives on the Council', ICE Archives, London: 185/01.
[17] 'The Institution of Civil Engineers: Advisory Committees', ICE Archives London: 185/01.
[18] According to Garth Watson, these were the functions of the Advisory Committees set up in yet other countries in the late 1940s. Garth Watson, *The Civils: the Story of the Institution of Civil Engineers* (London: Thomas Telford, 1988), pp. 235-6.
[19] IMechE *Proceedings*, Jan-May 1916, p. 12 (mentioned in the Annual Report for 1915).
[20] See Tables 3.1, 3.2 and 3.3 below.

the cotton and jute mills of Bombay and Calcutta, being virtually non-existent.[21] Indeed many British engineers who joined the PWD in the early twentieth century would already have been members of the ICE before their first posting, as Associate Membership of the ICE was one of the qualifications that made one eligible to apply for a PWD position.[22]

Within the broad identity of engineering in the British Empire, those working in India also began to see themselves, by the final decades of the nineteenth century, as having a particular expertise in engineering in the subcontinent. As Ian Derbyshire has shown, most of them spent decades, sometimes their whole working lives, in India. In many areas of railway engineering, they evolved a 'technologically syncretic' style of engineering that included elements of traditional Indian practices, often more labour-intensive than the prevailing Western norm.[23] In keeping with Derbyshire's argument about syncretism, examples may be found of India-based engineers referring to conditions peculiar to India in explaining certain features of their work to their metropolitan colleagues.[24]

Further, a shared experience of training undergone at colleges oriented towards Indian government services added to the sense of community among engineers working in different parts of India. These colleges (which are discussed further in Chapter 4) included the Royal Indian Engineering College (RIEC) at Cooper's Hill near London, set up in 1871 specifically to train engineers for the PWD, and the four Indian engineering colleges established in the nineteenth century at Roorkee, Madras, Poona and Sibpur (near Calcutta). While the full-time students of the Indian colleges were permanent residents of India, it appears that fresh engineers from Britain sometimes spent time at one of them as part of their acclimatisation to India.[25]

There was also some exchange of news and technical ideas with the founding of journals published in India, such as *The Indian and Eastern Engineer* and *Indian Engineering*.[26] The former was begun in 1858 by C.C. Adley,[27] a senior telegraph engineer in the company-run

[21] On the state of large-scale industries before World War I, see T. Roy, *The Economic History of India*, pp. 227-8; R.K. Ray, *Industrialization in India: Growth and Conflict in the Private Corporate Sector 1914-47* (New Delhi: Oxford University Press, 1982 [1979]), p. 4.
[22] 'Indian Public Works Department. Regulations as to Appointments of Assistant Engineers, 1910' in the *India Office List* for 1910, p. 222.
[23] Derbyshire, 'The Building of India's Railways', quoted phrase from p. 183.
[24] E.g. Joseph F. Strong, 'On the Apparatus Used for Sinking Piers for Iron Railway Bridges in India', *Proceedings of the Institution of Mechanical Engineers*, Vol. 14, No. 1 (1863), pp. 16-33 (including discussion). Strong referred in the discussion to the use of 'pounded brick instead of sand … for making the mortar' for the cylinders used in the bridge piers. He said that pounded brick 'was used everywhere throughout India in preference to sand, because the sand was too fine.' *Ibid.*, p. 28. See also Bradford Leslie in the discussion and correspondence on his paper 'The Erection of the "Jubilee" Bridge'.
[25] Derbyshire, 'The Building of India's Railways', pp. 181-2; see also Cuddy, 'Royal Indian Engineering College', Chapter 2.
[26] Derbyshire, 'The Building of India's Railways', p. 182.
[27] *Ibid*.

East Indian Railway. In its early years the journal bore the title *The Engineer's Journal and Railway, Public Works, and Mining Gazette, of India and the Colonies*; it was published from Calcutta and circulated across India.[28] The other journal, *Indian Engineering*, was started in 1887 as a weekly, under the editorship of Pat. Doyle, C.E. [Civil Engineer].[29] This journal contained a wide variety of articles dealing with PWD engineering, railway work and mill machinery among other topics,[30] while the editor stressed that contributions should relate to 'actual Indian practice.' The journal invoked a collective identity for engineers in India, and aimed to provide a 'means of intercommunication' between engineers belonging to '[t]he Profession throughout the country [which] is fast increasing in numbers and influence'.[31]

Local organisation

As this incipient colonial identity grew, engineers in India began to form local chapters of the London institutions. Around the 1910s, the ICE and IEE tried to set up local sections;[32] only the latter succeeded, establishing a Calcutta centre, though it has not been possible to ascertain how active it was.[33] Members of the IMechE appear to have had the most success in this direction. In 1907 IMechE members in and around Calcutta started to organise meetings to discuss papers. In January 1909 they formed, with the approval of the London Council, a Calcutta and District Section of the IMechE. Here members could meet face to face, present original papers, and discuss papers that had been read in London; some of the Calcutta papers and discussions were in turn excerpted in the IMechE's *Proceedings*.[34] By 1915-16 the Section had 88 members and was organising visits to engineering works in the Calcutta region.[35] Meetings were then

[28] *The Engineer's Journal and Railway, Public Works, and Mining Gazette, of India and the Colonies*, Vol. IV (Calcutta: Savielle and Cranenburgh, Printers, Bengal Printing Company Limited, 1861). As of 1861, C.C. Adley was Superintendent, East Indian Railway Electric Telegraphs. See the 'Address' to him from Radhamadhub Chuckerbutty and others, *Engineer's Journal*, Vol. IV, 2 December 1861, p. 219.
[29] 'Ourselves', *Indian Engineering*, 1 January 1887, pp. 1-2. The reference for the full volume is *Indian Engineering: An Illustrated Weekly Journal*, edited by Pat. Doyle, C.E., Vol. I, Jan-June 1887 (Calcutta: Printed by C.J.A. Pritchard at the "Star" Press, 19 Lall Bazar Street, 1887).
[30] 'General Index', *Indian Engineering*, Vol. I, pp. i-vi.
[31] 'Ourselves', *Indian Engineering*, 1 January 1887, pp. 1-2.
[32] 'Address by the President Edward Hopkinson, Esq., D.Sc., M.P.', Oct. 1919, in IMechE *Proceedings*, Oct-Dec 1919, pp. 631-58, here p. 655.
[33] IEE List of Members (as of 1 October 1919), p. 5. That the ICE did not succeed in setting up a local centre at this time is inferred from Hopkinson's Address (cited above), and confirmed by the ICE's official correspondence of 1926, considering afresh the creation of a local centre in India. ICE Archives, London: 185/03.
[34] See Annual Report for 1909, IMechE *Proceedings*, February 1910, pp. 343-83, here pp. 346-7 and p. 360. For an example of a paper presented first at Calcutta and then published in the *Proceedings*, see J.M. Christie, 'The Manufacture of Oxygen and its Use for Welding and Metal-Cutting', IMechE *Proceedings*, December 1916, pp. 889-894.
[35] Annual Report for 1916, IMechE *Proceedings*, Jan-May 1917, pp. 1-40, here p. 14.

suspended on account of the Great War.[36] According to a government report that commented on the matter in passing, the Section only had limited success as it '[had] not sufficient prestige to attract many members from other parts of India.'[37]

Even as the Calcutta Section suspended its activities, its Chairman began to receive letters from 'influential members' of the IMechE in India proposing possible alternative arrangements. In particular, they asked for a fully fledged Indian branch with a secretary, clerical staff, and its own lecture hall and reading room. This correspondence was forwarded to London. The Council, partly because of a lack of funds, declined to implement the suggestion. Instead it suggested the amalgamation of local sections of the London institutions in order to share the cost of providing technical libraries and other facilities. Apparently, this did not materialise.[38] It is not clear why members asked for an all-India branch as opposed to reviving the Calcutta Section (which appears to have lapsed permanently at the end of the war).[39] The reference to a lecture hall, reading room and staff suggests that what they wanted was a more permanent and more prestigious Indian base than the existing Calcutta Section.

Meanwhile, PWD engineers in India were organising themselves on a different basis. The process began in Punjab, which, with its network of irrigation canals, had more public works engineers than any other province in the country.[40] In 1912, ninety PWD engineers in that province, of whom 16 were Indians, came together to form the Punjab PWD Congress (the name was changed to Punjab Engineering Congress in 1916).[41] The Congress aimed 'to promote the well-being of the Department by affording members an opportunity of meeting annually to discuss subjects of professional or Departmental interest and for social intercourse.'[42] The founding Secretary, who continued in that post for several years, was W.S. Dorman, MICE,[43] (then an Executive Engineer in the Punjab PWD), and the first President was Sir H.P. Burt,

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[36] Annual Report for 1917, IMechE *Proceedings*, Jan-May 1918, pp. 1-41, here p. 11.
[37] Appendix H: 'Scientific and Technical Societies', *East India (Industrial Commission). Report of the Indian Industrial Commission 1916-18* (Cmd. 51, London: HMSO, 1919), pp. 385-7, here p. 386. This source is hereinafter cited as IIC Appendix H.
[38] Annual Report for 1918, IMechE *Proceedings*, Jan–May 1919, pp. 1-42, here pp. 10-11.
[39] The *Proceedings* of later years do not mention the Calcutta and District Section (as indicated by a digital search on http://pme.sagepub.com, 3/4 July 2012).
[40] See for example the listing of PWD engineers by province in the *India Office List* for 1914.
[41] 'History: Pakistan Engineering Congress an overview of 94 years', http://pecongress.org.pk/history.php, accessed 3 July 2012. The article is on the website of the successor institution of the Punjab Engineering Congress in Lahore.
[42] 'Rules', back matter (page numbers not contiguous with main text), *Minutes of Proceedings of the Punjab P.W.D. Congress*, Vol. I (Lahore: Civil and Military Gazette Press, 1913) [British Library Shelfmark: ST 1811].
[43] MICE: Member of the Institution of Civil Engineers; AMICE: Associate Member of the Institution of Civil Engineers.

AMICE (a senior railway official).[44] Gazetted (officer rank) engineers in the PWD and state-run railways could become members of the Congress. Municipal and district engineers holding recognised diplomas were permitted to join as Honorary Members, as were Royal Engineers from 1913. Residence in Punjab was not a requirement, and the annual subscription was Rs. 10.[45]

The Congress was an annual meeting where papers were presented and discussed. Between 1913 and 1920, an average of 10 engineering papers a year were presented at the Congress, whose membership at the end of this period was 220.[46] The Congress appears not to have had any regulatory or licensing functions. Nor did it have buildings of its own—Committee meetings took place at various venues in Lahore including the Town Hall and the PWD Secretariat. It was primarily a forum where PWD engineers could get to know a wide spectrum of their colleagues from the Punjab and elsewhere. Prestige was a factor: individual members delivering papers stood to win recognition not just from their immediate superiors but from a large body of officers, and could sometimes showcase their ideas or achievements to high government officials. The Lieutenant Governor of Punjab was invited to some of the annual sessions, as in 1920, when he described two papers from the previous year as having influenced him and his government in inaugurating specific engineering schemes.[47]

But the founders of the Punjab Congress had a larger ambition. They wanted similar PWD Congresses to be formed in other provinces, which could then be federated into an All-India PWD Congress, which would seek affiliation with the ICE in London. W.S. Dorman, the first Secretary, reported that in 1912-13 a Committee entrusted with promoting the All-India plan had sent out a letter to Chief Engineers across India, inviting to its next meeting 'any engineers desirous of taking the opportunity of seeing how the movement in the Punjab has been progressing.'[48] The plans came partly to fruition. By 1915, PWD engineers in Bombay and Burma had formed Congresses in their respective provinces. Although there remains the possibility that this was an independent development, the existence of a measure of cooperation

[44] Listed in *Min. Proc. Punjab P.W.D. Congress*, Vol. I (1913). On Dorman's long innings as Secretary, see A.S. Montgomery, Presidential Address, April 1920, in *Minutes of Proceedings of the Punjab Engineering Congress*, Vol. VIII (Lahore: Civil and Military Gazette Press, 1920), pp. i-vii, here pp. i-ii. On Dorman's career see Record of Services in *India Office List* for 1929. H.P. Burt became President of the Indian Railway Board in 1914-15. *Acworth Committee Report*, p. 3.
[45] 'History: Pakistan Engineering Congress'.
[46] A.S. Montgomery, Presidential Address, p. ii; 'History: Pakistan Engineering Congress'.
[47] 'History: Pakistan Engineering Congress'.
[48] Dorman, Annual Report and R.E. Purves, 'P.W.D. Congress. Note on the best means to be adopted for extending its influence.', back matter, p. 89 [page numbers not contiguous between main section and back matter] in *Min. Proc. Punjab P.W.D. Congress*, Vol. I.

by 1920 is indicated by the listing of papers read at these societies in the *Minutes* of the Punjab Congress.[49]

Therefore, although the Punjab PWD Congress was not a professional institution in the sense of the ICE or IMechE, its development is revealing of the kind of identity its founders wanted to build: an elite identity as engineer officers of the colonial government. By restricting itself to gazetted officers, the Punjab Congress limited its potential membership: in effect it excluded all engineers who were not employed by the government, e.g. engineers in company-run railways or private industries.[50] The 'profession' the Congress represented was thus a very specific one, which mapped directly on to the government engineering services across India. One member even hoped that those who belonged to the envisioned All-India Congress would eventually receive from the government an honorific such as CIES (Congress of the Indian Engineering Services), as a 'hall-mark of distinction.'[51] The idea of a post-nominal analogous to 'ICS'—which members of the prestigious Indian Civil Service bore—suggests an aspiration to a readily identifiable marker of status as a colonial government administrator.[52] The Congress's goal of being affiliated with the Institution of Civil Engineers also suggests that for the mainly British pioneers of the Punjab Congress, their Indian identity remained only a part of their larger identity as imperial engineers.

The foregoing discussion has highlighted the engineering profession's predominantly European composition, its bureaucratic character, and the metropolitan/imperial identity of its members in the long nineteenth century. These features, however, began to change in the interwar period.

War, government policy, and the formation of an Indian institution (c.1900-20)

As shown in Chapter 2, World War I catalysed significant constitutional reforms in India and caused fundamental changes in the colonial government's industrial and fiscal policies. As a result, the structure of government services, the nature of the economy, and the role of Indian

[49] *Minutes of Proceedings of the Punjab Engineering Congress*, Vol. VIII, pp. 135-142.
[50] Edward Hopkinson, in his 1919 presidential address to the IMechE, observed that '[t]he Members of the Public Works Department Congresses have realized that exclusion of all except Government Engineers, which was their policy until recently, was a mistake, and are taking steps to widen their constitutions.' 'Address by the President Edward Hopkinson', p. 655. The Punjab Congress eventually made their membership requirements less specific. See 'History: Pakistan Engineering Congress' on Ganga Ram's presidential year (1923/24).
[51] Purves, 'P.W.D. Congress', p. 92.
[52] As it happened, engineers in the top PWD ranks were able to use the letters ISE, for Indian Service of Engineers, after 1920; but this had nothing to do with membership of the PWD Congresses. On the ISE, see Chapter 4 below.

professionals in both were transformed considerably in the interwar years. Indianisation was set in train by the appointment of Royal Commissions, while a number of industries received economic protection, enabling the expansion of large-scale industrial enterprises in the 1920s and ’30s.

These changes had a marked effect on the composition of the engineering profession in India, which expanded, diversified, and was considerably Indianised. While the details of these changes are examined in the next three chapters, an analysis of membership trends of the London-based professional institutions illustrates the overall trajectory. The following tables show these statistics for the first four decades of the twentieth century.

Table 3.1: *Membership trends: Institution of Civil Engineers* [53]

	ICE			
Year	No. of India-resident members	As a percentage of worldwide membership	Number of 'native' names among India-resident members	'Native' names as a percentage of India-resident members
1901	538	7.32	30	5.58
1940	643	4.98	213	33.13

Note: The number of ICE members in India appears not to have varied much over this period. According to a contemporary, the ICE had about 600 members in India in 1919.[54]

Table 3.2: *Membership trends: Institution of Mechanical Engineers*

	IMechE			
Year	No. of India-resident members	As a percentage of worldwide membership	Number of 'native' names among India-resident members	'Native' names as a percentage of India-resident members
1901	124	3.87	7	5.65
1919	360	5.45	25	6.94
1930	620	5.77	90	14.52
1940	691	5.05	214	30.97

Table 3.3: *Membership trends: Institution of Electrical Engineers*

	IEE			
Year	No. of India-resident members	As a percentage of worldwide membership	Number of 'native' names among India-resident members	'Native' names as a percentage of India-resident members
1902	99	2.25	13	13.13
1919	299	3.84	75	25.08
1930	771	5.47	372	48.25
1939	1445	7.57	993	68.72

[53] Tables 3.1, 3.2 and 3.3 are based on the Lists of Members of the ICE, IMechE and IEE respectively (consulted at the archives of the ICE, IMechE and IET respectively, all in London). The figures are only indicative, for a variety of reasons: a) where topographical listings are not made, the number of India-resident members is estimated by counting names with identifiably Indian addresses; b) the count for 'native' names may not account for some Anglo-Indian names that are indistinguishable from European names; c) occasional anomalies occur, such as the appearance of names without addresses—in which case they are not taken into account. Further, Burma and Ceylon (Sri Lanka) are sometimes listed along with India and sometimes separately. For consistency, they have been included in all totals given here. Finally: where possible, the latest list for a particular year is used.

[54] 'Address by the President Edward Hopkinson', p. 654.

Some patterns are immediately visible. First, the overall membership of the three institutions in India showed a substantial increase over this period, indicating an expanding engineering profession. Second, this increase was much more dramatic for the IMechE and the IEE than for the ICE (whose membership started at a much higher number but did not increase as rapidly), indicating that the major growth area in Indian engineering after World War I was in private industry, which accounted for most electrical and mechanical engineers. Third, the percentage of 'native' members among the India-resident members of the three institutions increased dramatically, suggesting an increasing Indianisation of the profession. Thus the engineering profession reflected the interwar trends of industrialisation and Indianisation.

In keeping with these trends, there occurred another important development in 1920: the establishment of a new professional society on Indian soil, the Calcutta-based Institution of Engineers (India). This institution owed its existence in large part to the report of the Indian Industrial Commission (1916-18). In proposing that the state should abandon its *laissez faire* policy and actively encourage industrialisation, the IIC's report highlighted the government need for 'reliable scientific and technical advice.'[55] To provide such advice, the Commission proposed not only to reorganise the government's scientific services, but also to set up professional societies that would include privately employed technical experts in addition to government officers.[56] They envisioned these as 'Indian institutes, societies and associations analogous to the Institution of Civil Engineers, the Chemical Society, and the British Association for the Advancement of Science.'[57] One such society would be 'an Indian Institution of Engineers embracing all the branches of engineering practised in India.' This would guide the government in its project of industrialisation, advising it on regulatory matters like the certification of boiler attendants, laws relating to engineering, and licences for mineral resources and water power. It would also advise on engineering education, and help in 'establishing a standard of professional conduct and efficiency' among engineers.

As the IIC envisioned it, the new institution would be significant in two ways. First, it would embrace private as well as public engineers. This was important as industrialisation would mean more engineers employed in private industry. Second, along with the other proposed professional societies, it would help meet 'the growing needs of Indians' by allowing

[55] 'The Indian Industrial Commission: its report summarised', p. 1, in *East India (Industrial Commission). Report of the Indian Industrial Commission 1916-18* (Cmd. 51, London: HMSO, 1919).
[56] 'The Indian Industrial Commission: its report summarised'; also Indian Industrial Commission 1916-18, *Report* (Calcutta: Superintendent Government Printing, India, 1918), point 42, p. 277. The last of these sources is hereinafter cited as *IIC Report*.
[57] IIC Appendix H, p. 385.

them to participate in professional meetings and discussions. Although they could join the English and American professional societies, Indian engineers did not gain much from this 'beyond the prestige attaching to membership and the periodic receipt of copies of publications', as they did not ordinarily have opportunities to travel to Britain or the USA. The new Institution of Engineers, in contrast, would be located in India. Furthermore, the IIC wanted it to follow the practice of the IMechE in Britain by setting up local centres in different parts of India, thus allowing greater numbers of engineers to attend meetings, present and discuss papers.[58] However, as discussed later, this did not mean that the institution would be solely for Indians—only that they would be as welcome as Europeans.

In India Sir Thomas Holland, President of the Indian Industrial Commission, led the movement for the new institution. Holland had previously played leading roles in other professional institutions. He was a co-founder (1906) and the first President of the Mining and Geological Institute of India; President of the Manchester Geological and Mining Society (1913); and President of the Institution of Mining Engineers, London (1915-16).[59] As Director of the Geological Survey of India (1903–c.1910),[60] Holland had proved himself a keen administrator and reformer, and was instrumental in the Survey's attainment of 'a position of prestige in India, both with Government and with the public'.[61] In 1917 he became President of the Munitions Board,[62] and was thus a central figure in India's contribution to the British war effort. The proposed Indian Institution of Engineers could scarcely have had a more influential champion.[63]

The proposal coincided with the demands for all India-branches (as outlined above) by the India-resident members of some of the London engineering institutions. The 'home' institutions—in particular the IMechE and the IEE—could now meet these demands by asking their members in India to join the new Indian institution, over which they initially harboured hopes of exerting control from London. As the annual report of the IMechE for 1918 put it,

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[58] IIC Appendix H.
[59] L.L. Fermor, 'Thomas Henry Holland. 1868-1947', *Obituary Notices of Fellows of the Royal Society*, Vol. 6, No. 17 (November, 1948), pp. 83-114, here p. 90.
[60] Roy M. MacLeod, 'Holland, Sir Thomas Henry (1868–1947)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 (http://www.oxforddnb.com/view/article/33945, accessed 11 June 2012).
[61] Fermor, 'Thomas Henry Holland', p. 85.
[62] MacLeod, 'Holland, Sir Thomas Henry (1868–1947)'.
[63] Holland's importance in this matter is indicated in several ways. He was Chairman of the Industrial Commission, which recommended the setting up of the Institution; he presided over a meeting in Calcutta where the decision to form the new Indian institution was taken (see 'Address by the President Edward Hopkinson', here p. 655); IIC Appendix H appears to draw on Holland's experience, mentioning the Mining and Geological Institute of India as an example of previous successful institutions in India.

> The Council have … expressed their willingness, should the members resident in India so desire, to consider [a] proposal which they are aware is under discussion in India for the establishment of an Indian Institution of Engineering, incorporated by charter or otherwise, so as to form a corporate body of the members of the Institutions of Mechanical and Electrical Engineers in India, in close association with and affiliated to the Home Institutions, and receiving their financial support. The Council, however, consider that full membership of such an Institution, i.e., membership with full privileges and voting power, should be dependent on membership of one of the Home Institutions, though not thereby precluding admission to other grades of membership with limited privileges, such as Associate and Graduate, subject to qualifications similar to those now required by the Home Institutions.[64]

The interest in maintaining some influence over the Indian institution remained, but the idea of direct metropolitan control was soon dropped—possibly because it met with resistance in India. That some negotiation occurred is likely: the new President (1919) of the IMechE, Edward Hopkinson, would have known personally the proponents of the Indian institution, as he had himself been a member of the Indian Industrial Commission before resigning when he was advised, on medical grounds, against travelling to India in November 1917.[65] As Hopkinson explained in his presidential address of October 1919,

> it is [now] generally conceded both here and in India that it is better that the Indian Society, knowing the wants of its own members and the local conditions, should devise its own constitution independently. At the same time, it is, I think, incumbent upon our Institution to use its influence in maintaining a high qualification for membership in the Indian Society and to collaborate with it with a view to obtaining the benefits for our own members in India, which such a Society can provide.[66]

In other words, the London institutions found it expedient to support the proposal for a new institution in India, but were anxious that such association should not be construed as lowering the metropolitan standards of the profession. Stringent entry requirements to the Indian institution would ensure that the IMechE's members in India would not, in joining or working with the new institution, have to associate with a local profession of a lower standard.

Nevertheless, the endorsement of the London institutions continued, and with the influential figure of Thomas Holland in India to shepherd it through, plans for the new Indian institution progressed swiftly. Prominent engineers met in various parts of the country to discuss

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[64] IMechE *Proceedings*, Jan-May 1919, pp. 11-12.
[65] 'Engineering Heritage: Past Presidents', http://heritage.imeche.org/Biographies/pastpresidents (accessed 14 April 2012); *IIC Report*, pp. xv-xvi.
[66] 'Address by the President Edward Hopkinson', p. 656.

the proposal. Holland organised an initial meeting in Calcutta in 1919; an organising committee was formed; a constitution was drafted and circulated among engineers across India. In September 1920 the Institution of Engineers (India) (or IEI) was formally registered under the Indian Companies Act.[67] It started functioning from Calcutta soon after, whereupon '[t]he goodwill of the older Institutions' was 'promptly and handsomely expressed'.[68]

The London institutions, in supporting the new institution, recognised the fact that it was not in direct competition with them. Joining the IEI did not mean that engineers in India would cease to become members of the ICE, IMechE or IEE: as Tables 3.1, 3.2 and 3.3 above showed, large numbers of both Britons and Indians continued to be members of these institutions in the decades after the IEI was founded. Yet, for a community of engineers that had earlier seen itself as part of an Empire-wide profession, the IEI signified the possibility of another, more specific, identity. Its formation was part of a wider trend: STM practitioners had begun to organise themselves in pan-Indian societies. David Arnold has described the growth of an 'Indian scientific community' from 1890 onwards, which entered a defining phase with the formation of the Indian Science Congress in 1914. The Science Congress enabled the participation of university-based scientists (and more Indians) alongside members of the (European-dominated) government scientific services in an annual discussion of papers.[69] An Indian Medical Association was formed in 1928 by doctors opposed to metropolitan control of the profession and its domination by the Indian Medical Service, although it was some years before it was able to bring about any changes in the situation.[70] All these developments were related directly or indirectly to the twentieth-century constitutional reforms that paved the way for greater Indianisation and provincial autonomy. The Indian Industrial Commission was conscious of these broader developments in STM: in recommending the creation of an Indian institution for engineers, the IIC had referred approvingly to the early success of the Indian Science Congress.[71]

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[67] H. Nandy (ed.), *IEI marches on* (Kolkata: Cdr. A.K. Poothia for Institution of Engineers (India), 2002 [1996]), pp. 5-6.
[68] Hugh W. Brady, 'The Origin, Character and Prospects of the Institution', *The Journal of the Institution of Engineers (India),* Vol. 1 (September 1921), pp. 30-37, here p. 37.
[69] David Arnold, *Science, Technology and Medicine in Colonial India*, Chapter 5.
[70] Jeffery, 'Recognizing India's Doctors'; according to the IMA's website, many of its early proponents were 'active in the Indian national Congress'. 'IMA in Retrospect', at http://www.ima-india.org/IMA_history.html (accessed 12 April 2012).
[71] IIC Appendix H, p. 386.

The IEI and the growth of an Indian engineering profession, 1920-47

The establishment of the IEI and its interwar activities offer important insights into the emergent Indian professional identity of engineers, and their relationship with the state. Throughout this period, the IEI's primary source of legitimacy was its endorsement by the colonial state. The Institution was an incorporated body from the beginning (registered, as we saw above, under the Indian Companies Act). In 1935 it went a step further, obtaining a Royal Charter.[72]

The text of the 1935 Royal Charter—which formalised the IEI's existing goals[73]—gives an accurate idea of the envisaged functions of the IEI throughout the period 1920-47. Broadly speaking, the IEI was similar to the London institutions in form and purpose. It aimed to promote technical knowledge through paper discussions and publications; to play a role in engineering education through classes and examinations for working persons; to provide technical advice to the government on behalf of the engineering profession; and to act as a governing body to regulate the conduct of its members and 'promote efficiency and just and honourable dealing and … suppress malpractice in engineering.'[74] Despite these similarities, though, three particular objectives of the IEI are worth stressing as being somewhat different from those of the London Institutions. First, the Institution was to encompass all branches of engineering.[75] Second, it sought to promote Indian industrialisation, reflecting its genesis in the recommendations of the IIC.[76] Third, it was to encourage Indianisation in the engineering profession—again reflecting the Industrial Commission's view, quoted earlier, that professional societies were needed in India to cater to the 'the growing needs of Indians'. Below I will show how the Institution attempted to fulfil these manifold functions, and relate this to the emergence of an Indian professional identity among engineers in the interwar period.

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[72] Nandy (ed.), *IEI marches on*, p. 11.

[73] As will be seen in this section, the IEI's activities were essentially marked by continuity before and after the award of the Charter (1935).

[74] Annexure IV: 'Royal charter', Nandy (ed.), *IEI marches on*, pp. 78-88.

[75] According to the IEI's Charter, the overall objective of the Institution was '[t]o promote and advance the science, practice and business of Engineering in all its branches … in India.' *Ibid.* The origins of the decision to cover all branches of engineering lay at least partly in pragmatic considerations. As the IIC had observed, there were not yet sufficient numbers of engineers in India to form several specialised institutions of engineers. IIC Appendix H, p. 386. In any event, the all-branches principle appears to have become a definite part of the IEI's identity: the Institution continues to cover all branches of engineering to the present day.

[76] As the Charter put it, the IEI would '[facilitate] the scientific and *economic* development of Engineering in India', and 'encourage inventions and investigate and make known their nature and merits.' Annexure IV: 'Royal charter'. Emphasis mine.

The discussion of papers was an important part of the IEI's activities from its inception. The Institution established an annual *Journal of the Institution of Engineers (India)* in its first year. The *Journal* began by publishing a handful of papers every year, but by 1939 it had become a quarterly, and by the 1940s it featured papers, reports from the Institution's regional sections (of which more below), book reviews and engineering news from around the world.[77]

The IEI rapidly took on some of the roles the Industrial Commission had envisaged for it, advising the government and representing the Indian profession in international organisations for technical standards. These organisations worked for governments and industry, developing standards in order 'to secure interchangeability of parts, to cheapen manufacture…, and also to expedite delivery'.[78] In 1922 the IEI's Council became the Indian Committee of the British Engineering Standards Association (BESA; later British Standards Institution); the following year it was made the Indian National Committee for the International Electrotechnical Commission (IEC). The IEI continued to represent India on these bodies until after Independence, when the new Indian Standards Institution took over both functions.[79]

The IEI had the standard system of graded membership, the body corporate consisting of Members and Associate Members, who attended General Meetings and voted on decisions of the Institution.[80] While it has not been possible to identify the exact procedure by which members were admitted in the early years, it is almost certain that specific educational qualifications and experience were required, with the Council then voting on each case. (Annual reports, starting with the first year, refer to the number of members 'elected'.)[81] From 1928 onwards, candidates' theoretical knowledge was tested by the IEI's Associate Membership examinations.[82]

In fact the Associate Membership examination was more than a way to select entrants to the Institution. It was also designed as a contribution to engineering education by creating a

[77] See the IEI *Journal* in the 1920s, e.g. Vol. VII (December 1927), Vol. VIII (April 1929) and Vol. IX (May 1930); IEI *Journal*, Vol. XXVI, No. 2, Part 1 (December 1945); Nandy (ed.), *IEI marches on*, p. 27.
[78] C. LeMaistre, 'Summary of the Work of the British Engineering Standards Association', *Annals of the American Academy of Political and Social Science*, Vol. 82, 'Industries in Readjustment' (March 1919), pp. 247-252, here p. 247. LeMaistre was then Secretary of the BESA.
[79] Institution of Engineers (India), Yearbook 1964-65 (Calcutta: [Institution of Engineers], 1965), p. 6. Available at British Library (Shelfmark: General Reference Collection P.621/409).
[80] Annual Reports in IEI *Journal*, various years; Annexure IV: 'Royal charter', pp. 85-6.
[81] See IEI *Journal*, Vol. II (April 1922), p. 139; IEI *Journal*, Vol. XVIII (August 1938), pp. 6-16.
[82] The original constitution or rules of the Institution for our period have not been found, but the present (2012) bye-laws, which are the result of several successive amendments to those drafted in the 1930s, stipulate certain experience requirements and a possible interview in addition to the Associate Membership examination or equivalent qualifications. For Associate Members, the minimum age is 26 and the candidate should have had 'at least five years professional engineering experience in a position of responsibility.' IEI Bye-Laws effective 5 May 2012, http://www.ieindia.info/PDF_Images/Bylaws/ByeLaws.pdf (downloaded 2 July 2012). See also 'The Royal Charter, the early years and the bye laws', Nandy (ed.), *IEI marches on*, pp. 11-20.

qualification for individuals who, though not in possession of a degree or diploma, were engaged in engineering work. This would have constituted an important opportunity for Indians in subordinate positions in industry who had not had the chance or the means to attend an engineering college. By 1939, passing Sections A and B of the Associate Membership examination had been accepted as equivalent to a degree by the governments of Punjab, Bengal, the United Provinces, the Central Provinces, Burma and Travancore, and by the Federal Public Service Commission.[83] Thus an engineer with IEI qualifications could apply for certain government engineering jobs even if he did not possess formal qualifications.[84] The IEI in turn exempted the holders of engineering degrees from certain universities from taking its A and B exams when they sought admission to the Institution.[85] Judging by the success rate of candidates, the Associate Membership exams were of a high standard. In the exams held in October 1933, only 7 out of 19 candidates passed Part A, while 6 out of 17 passed Part B. The results in later years were similar. In 1936-7, 14 out of 29 candidates passed Section A of the exam; 4 out of 15 passed Section B. The results for 1944-5 were: 17 passed out of 53 (Section A) and 9 out of 36 (Section B).[86]

Under the provisions of its 1935 Charter (which had been 'vigorously pursued by Sir Rajendra Nath Mookerjee [President, 1920-1] and followed up strongly by succeeding Presidents'),[87] Members and Associate Members of the IEI were allowed to style themselves 'Chartered Engineer (India)'. They could also use the post-nominals MIE (Ind) and AMIE (Ind) respectively.[88] This form of recognition, or 'informal licensing' in Buchanan's words, was particularly important in a profession which did not require compulsory registration. As *Indian Engineering*—the Calcutta-based journal described earlier—commented in 1925 in the context of the British profession, anyone could 'put C.E. after his name, and call himself a civil engineer, if he is a plumber or a glazier or house-decorator or nothing at all … But a *chartered* civil engineer is another affair, the designation implies certain qualifications'.[89] The corollary of the power to certify an engineer's competence was the need to police the conduct of members.[90]

[83] IEI *Journal*, Vol. XX (January 1941), p. 29.
[84] This was not limited to British India. For example, around 1946, the princely state of Travancore recognised the AMIE (Ind.) qualification for the purpose of recruitment to its engineering services. IEI *Journal*, Vol. 26, No. 3 (March 1946), p. 69.
[85] IEI *Journal*, Vol. 26, No. 3 (March 1946), p. 69.
[86] IEI *Journal*,Vol. XV (July 1935), p. 6; IEI *Journal*, Vol. XVIII (August 1938), p. 13; IEI *Journal*, Vol. 26, No. 3 (March 1946), p. 68.
[87] Nandy (ed.), *IEI marches on*, p. 11. See Annexure III, *ibid.*, pp. 75-7, for the year of Mookerjee's Presidency.
[88] Annexure IV: 'Royal charter', p. 86.
[89] Lead article, *Indian Engineering*, 17 June 1925, pp. 351-2, here p. 352.
[90] Annexure IV, 'Royal charter', p. 81 (paragraph 2(j)).

In August 1944, the IEI brought into force its 'Professional Conduct Rules' (Code of Ethics from 1954).[91]

The designation 'Chartered Engineer (India)' was also significant in that it indicated a specifically Indian professional identity—Indianness being defined not by the race of an engineer but by his geographical field of operation. Although it was not a legal requirement, the prestige of such a qualification must have been attractive to a young Indian engineer with no other affiliations. Other engineers (British and Indian) who were already members of the Empire-wide profession via the London institutions also found it advantageous to join the IEI, the MIE (Ind) or AMIE (Ind) badge perhaps indicating an additional India-specific expertise. Some engineers played leading roles in a 'home' institution as well as in the IEI, as in the case of R.D.T. Alexander, a member of the India Advisory Committee of the ICE who later became President of the IEI.[92]

From the start the IEI established a decentralised structure, with local centres in several Indian provinces 'for closer and efficient interchange [sic] of information and views.'[93] The membership of the Institution was distributed among these centres, presumably on the basis of members' place of residence.[94] The local centres organised their own lectures, paper discussions, and visits to engineering works in addition to the activities of the Institution as a whole.[95] As of 1937, there were local centres for Bengal, Bombay, South India, the United Provinces, Mysore, North West India, and even for members outside India.[96] The all-India membership increased steadily over the inter-war years and beyond, as shown by the table below:

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[91] Nandy (ed.), *IEI marches on*, p. 33. In this sense, the engineering institutions in Britain and India were different from those for the medical profession—where one body (e.g. the General Medical Council in Britain) licensed/regulated practitioners, and another (e.g. the British Medical Association) represented the interests of practitioners. In the engineering case, the same institution could represent the profession's interests and regulate it.

[92] Annexure III, Nandy (ed.), *IEI marches on*, pp. 75-7; R.D.T. Alexander to Secretary of the ICE, 26 April 1926, part of the ICE's official correspondence of 1926 considering the creation of a local centre in India. ICE Archives, London: 185/03. Examples of Indians who were members of 'home' institutions and of the IEI are Fakirjee E. Bharucha, MIMechE., MIE (Ind.) and C.V. Krishnasawami Chetty, AMIEE, MIE (Ind.) (as of the late 1930s), both of whom are mentioned later in this chapter.

[93] According to B.N. Chaudhuri, M.I.E., 'A short history of the growth and development of the Institution of Engineers (India)' in *Demicenturion* (IEI Commemorative volume [1969]), p. 43ff. The volume is available at the Library of the IEI, at its Kolkata Headquarters at 8 Gokhale Road. The Indian Industrial Commission had envisaged the IEI as having local associations as the IMechE did in Britain. IIC Appendix H, pp. 386-7.

[94] Membership totals in Annual Reports, IEI *Journal*, various years.

[95] See IEI *Journal*, Vol. XVIII (August 1938), p. 10.

[96] See Annual Report for year ending 31.8.1937, in IEI *Journal*, Vol. XVIII (August 1938), pp. 6-16.

Table 3.4: *Membership figures, Institution of Engineers (India)*[97]

Year	**Corporate members** (Members, Associate Members)	**Non-corporate members** (Hon. Members, Students, etc.)	**Total number of members**
1920	138	-	[138]
1930	920	192	1,112
1940	1,190	228	1,418
1950	4,168	3,140	7,308

It must be noted here that the IEI's growth was not entirely unopposed. At the beginning, the Institution's eclectic character pitted it against one particular group of engineers in India: the PWD Engineering Congresses. J.W. Meares, a member of the IEI's first Council,[98] recalled in his 1934 autobiography that the Congresses had opposed the new institution fiercely:

> We realized very early that if this body was to take its place alongside the great engineering Institutions of England and America it must work entirely through "local associations" in the various provinces. A nucleus existed in certain annual congresses held in [some] of the large centres, and we thought they would naturally welcome a co-ordinating body which would weld them all into a harmonious whole. The Government of India encouraged us, the Viceroy came to our inaugural meeting; and every one worked hard to ensure the success that will surely come presently, and is in fact now in sight. Nevertheless these isolated congresses one and all preferred at first to continue to plough their lonely and unproductive furrows, unknown beyond the borders of their own cities, rather than join up and become powerful in the councils of India.[99]

In fact, the Congresses were hostile not because they wanted to remain confined to their provinces, but because they had their *own* vision of an all-India institution. As we have seen, the Punjab Engineering Congress had been hoping for some years to spearhead a pan-Indian PWD engineering movement of civil-engineer officers by federating the various provincial congresses (and had made some progress in this direction). Understandably, it viewed the Calcutta-based IEI, headed by men such as geologist Thomas Holland, electrical engineer J.W. Meares, and engineer-businessman R.N. Mookerjee (a member of the Indian Industrial Commission, 1916-

[97] Nandy (ed.), *IEI marches on*, p. 34.
[98] IEI *Journal*, Vol. I (September 1921), p. 15.
[99] John Willoughby Meares, 'At the Heels of the Mighty: being the Autobiography of "Your obedient humble servant"' (typescript, 1934), IET Archives London: SC 169/1/1, p. 236. Meares was, in the course of his career, Electrical Adviser to the Government of India and Chief Engineer, Hydroelectric Survey of India.

18 and President of the IEI, 1920-1) as a usurper.[100] According to Meares, W.S. Dorman, the long-time Secretary of the Punjab Engineering Congress, 'wanted to continue bossing the show there', and the Congress 'did its utmost to queer the pitch for us [the IEI]'.[101]

Some members of the PWD Congresses also found the relatively inclusive IEI antithetical to their own elitist ambitions. J.W. Mackison, a municipal engineer in Bombay, recalled in 1926 that '[w]hen the recently formed Indian Engineering Society was started the Council of the Bombay Engineering Congress unanimously agreed, not to have anything to do with it.' Mackison claimed that the IEI had admitted several engineers whom the Congress had turned away. 'Many here,' he reported, 'regard [the IEI] as a back door for admission to the Institution of Civil Engineers.'[102] Strictly speaking, this could not have been the case, as admission to the IEI did not automatically entitle one to membership of the London institutions. Mackison probably meant that whereas the PWD Congresses had wanted to gain the imprimatur of the ICE, the IEI now had that privilege. The 'back door' may also have been a reference to the fact that while the provincial Congresses were for gazetted (usually civil engineer) officers in the PWD and state railways, the IEI accepted engineers working in private industry, outside the gentlemanly paradigm of the PWD (which I discuss in Chapter 4).

However, as *Indian Engineering* pointed out, the PWD Congresses and the IEI were fundamentally different types of association—a congress was merely an annual meeting for the discussion of papers on engineering, and could not carry out the governing functions that the IEI did.[103] Whether out of recognition of this fact or the increasing evidence that the IEI had the blessing of the state, the PWD Congresses gradually reconciled themselves to cooperating with the Institution. As early as 1920, the President of the Punjab Congress, A.S. Montgomery, referred to the provincial Congresses' aim to combine into a nation-wide organisation, declaring that '[t]he seed thus sown has sprung up into the Institution of Engineers (India), and we may rightly claim, in my opinion, the majority of the credit for its creation.'[104] A few years later, G.H. Thiselton Dyer, President of the Bombay Engineering Congress, made a similar argument. He declared that his organisation was not in competition with the IEI, going so far as to say that if the Congress had eventually to be dissolved due to dwindling membership, they would at

[100] For Mookerjee's membership of the Industrial Commission, see *IIC Report*, p. xvi; on his life and career, see K.C. Mahindra, *Rajendra Nath Mookerjee: A Personal Study* (Calcutta: Art Press, [1933]).
[101] Meares, 'At the Heels of the Mighty', p. 397. Dorman, the founding Secretary of the Punjab Engineering Congress, was still Secretary as of 1920. See A.S. Montgomery, [Punjab Congress] Presidential Address, pp. i-ii.
[102] J.W. Mackison to A. A. Biggs, 30 March 1926, supporting proposal for a Local Association of the ICE in India, ICE Archives, London: 185/03.
[103] Lead article, *Indian Engineering*, 17 June 1925, pp. 351-2, here p. 352.
[104] A.S. Montgomery, Presidential Address, pp. i-ii.

least draw satisfaction from having been an early contributor to the establishment of an Indian engineering institution.[105] In some cases, important figures from the Engineering Congresses were also co-opted by the IEI. B.P. Varma, an irrigation engineer who had been influential in forming the Engineers' Association, Punjab (a forerunner of the Punjab PWD Congress), became President of the IEI in 1934-5;[106] while Sir Ganga Ram, a distinguished Roorkee alumnus, served on the Council of the IEI in 1922 and as President of the Punjab Congress the following year.[107] In 1943, the Bombay Engineering Congress was merged with the IEI.[108] The Punjab Congress, while cooperating with the IEI, remained a separate entity.[109]

Indianisation and industrialisation

The IEI's distinguishing characteristic in the interwar period was its emphasis on Indianisation and industrialisation. This was referred to by Sir R.N. Mookerjee (1854-1936), President of the Institution for 1920-1, in his Inaugural Address. Mookerjee saw the formation of the IEI as heralding an era of equality, lauding 'the spirit of comradeship and cooperation in which British engineers have extended the hand of fellowship to their Indian colleagues.' He also saw the Institution as a means 'to promote the efficiency and training of Indian engineers', the better for them to harness India's plentiful natural resources in the cause of industrialisation.[110]

In fact Mookerjee's election as President in the first full year of the Institution's functioning was itself symbolic of the twin priorities of industrialisation and Indianisation. Unlike most of those who had represented Indian engineering in the past, he was not a colonial government officer. Instead, at a time when 'native' Indian engineers had limited opportunities, he had developed a successful career as an engineer-businessman. Starting as a contractor, he

[105] 'Engineering Congresses', *Indian Engineering*, 28 March 1925, pp. 169-70. The article refers to Thiselton Dyer's Presidential Address at the ninth Bombay Engineering Congress.
[106] See 'Presidential Address by Rai Bahadur B.P. Varma: President 1934-5', IEI *Journal*, Vol. XV (July 1935), pp. 11-18.
[107] IEI *Journal*, Vol. 2 (April 1922), p. 137; 'History: Pakistan Engineering Congress'. On Ganga Ram's career, see 'Biographical Notes', appendix to K.V. Mital, *History of the Thomason College of Engineering (1847-1949): On which is Founded the University of Roorkee* (Roorkee: University of Roorkee, 1986), pp. 260-6, here p. 262.
[108] Nandy (ed.), *IEI marches on*, p. 18.
[109] According to the website of the Punjab Congress's successor institution: 'For nearly thirty years with the Institution of Engineers India and, later on with the Institution of Engineers Pakistan the stand taken by the Congress has been that it would welcome an association which does not amount to merger or loss of its own identity.' See 'History: Pakistan Engineering Congress'.
[110] Annexure-II: 'The Inaugural Address', Nandy (ed.), *IEI marches on*, pp. 65-74, here p. 66 and p. 70. The dates of Mookerjee's life-span are mentioned in P.C. Mahalanobis, 'Sir Rajendra Nath Mookerjee: First President of the Indian Statistical Institute 1931-1936', *Sankhyā*: *The Indian Journal of Statistics*, Vol. 2, Part 3 (1936), pp. 237-40.

co-founded the engineering firm Martin & Co. (later Martin Burn & Co.) in Calcutta.[111] He also took a strong interest in developing the education and career prospects of his compatriot engineers. In 1910 he had suggested that a central technical college be created in India, rather than sending Indians abroad for technical training. He was also instrumental in the opening of the East Indian Railway's Kanchrapara workshop to Indian apprentices.[112]

While it has not been possible, in the absence of complete lists of members, to establish the Indian share of the IEI's overall membership, the list of Mookerjee's successors as President indicates a gradual Indianisation of the professional elite. Table 3.5 below shows that of the 22 Presidents until and including 1939-40, eight were Indian. (In the following decade only one President was a European.)[113]

111 'Life and work of Sir Rajendra Nath Mookerjee: The Inaugural-President of The Institution of Engineers (India)' in *The Institution of Engineers (India), Diamond Jubilee 1980: Souvenir* (Calcutta, 1980), pp. 35-37; K.C. Mahindra, *Rajendra Nath Mookerjee: A Personal Study* (Calcutta: Art Press, [1933]).
112 'Life and work of Sir Rajendra Nath Mookerjee'.
113 The assumption here is that none of the European names refers to an Anglo-Indian.

Table 3.5: *Presidents of the Institution of Engineers (India), 1920-40* [114]

Year	Name	Field of work (if known)	Designation at the time of Presidentship (if known)	Source for Field/ Designation
1920 (before formal registration)	Sir Thomas R. J. Ward	PWD	Inspector–General of Irrigation, India. (Retd. Jun 1921)	*India Office List* (IOL) for 1940
1920-1	Sir Rajendra Nath Mookerjee	Private industry	Co-founder, Martin & Co, Calcutta	Biography by K.C. Mahindra[115]
1921-2	Col. Sir George Willis	Military	Mint Master, Bombay	IOL 1940
1922-3	A.C. Coubrough			
1923-4	Sir Clement D.M. Hindley	Railways	Chief Commissioner, Railway Board	IOL 1940
1924-5	H. Burkinshaw			
1925-6	Dewan Bahadur A.V. Ramalinga Aiyar	PWD		IOL 1920
1926-7	W.H. Neilson			
1927-8	Sir James S. Pitkeathly	Indian Stores Dept.	Chief Controller of Stores	IOL 1940
1928-9	Lt. Col. R.D.T. Alexander			
1929-30	Lt. Gen. Sir Edwin H. de Vere Atkinson	Military	Master-General of Ordnance	IOL 1940
1930-1	C. Addams Williams	PWD	Chief Engineer	IOL 1940
1931	Diwan Bahadur N.N. Ayyangar	PWD		IOL 1940
1931-2	Raja Jwala Prasad	PWD	Chief Engineer; retd. Nov 1931	IOL 1940
1932-3	Dr A. Jardine	Private industry	a director of Jessop & Co., engg. contractors	Obituary in ICE *Proceedings*[116]
1933-4	Thomas Guthrie Russell	Railways	Chief Commissioner, Railway Board	IOL 1940
1934-5	B.P. Varma	PWD		IEI *Journal*[117]
1935-6	F.C. Temple			
1936-7	Rai Bahadur Chhuttan Lal	PWD	Chief Engineer; retd. 1937)	IOL 1940
1937-8	Fakirjee E. Bharucha	Pvt. industry (textile mills)		IEI *Journal*[118]
1938-9	E.J.B. Greenwood	PWD	Govt. Electrical Inspector, Madras, as of 1920	IOL 1920
1939-40	Khan Bahadur M. Abdul Aziz	PWD	Chief Engineer rank	IOL 1940

[114] Dates and names of Presidents are given in Annexure III, Nandy (ed.), *IEI marches on*, pp. 75-7. Their occupations were ascertained from various sources, listed in the table itself.

[115] K.C. Mahindra, *Rajendra Nath Mookerjee: A Personal Study* (Calcutta: Art Press, [1933]). While Mookerjee's designation in his company in 1920 has not been ascertained, he was Senior Partner some years before. *Ibid.*, p. 200.

[116] 'Alexander Jardine, DSc', obituary appearing in ICE *Proceedings*, Vol. 48, Issue 4 (April 1971), pp. 723-4.

[117] See 'Presidential Address by Rai Bahadur B.P. Varma'.

[118] 'Presidential Address by Mr. Fakirjee E. Bharucha, M.I.Mech.E., M.I.E. (Ind.): President 1937-38', IEI *Journal*, Vol. XVIII (August 1938), pp. 17-30.

Indianisation notwithstanding, the IEI was no revolutionary body. As Table 3.5 shows, many Presidents were senior officials in the government services, mainly the PWD and Railways. Hugh W. Brady, the first Secretary of the Institution, felt that 'a large proportion of our membership will always be European'.[119] Certainly there continued to be several enthusiastic European members. As late as 1938, the IEI reported that it had created a London office and a 'London Committee' in order to enable 'members of the Institution on home leave to get into touch with each other and with the Institution, and also to arrange for the Annual Institution Luncheon.'[120] Nevertheless, Presidents of the IEI in Calcutta often placed emphasis on the Indian members in their annual addresses, initially in somewhat paternalistic terms. W.H. Neilson (President 1926-7), speaking in the context of the low number of papers submitted to the Institution in its early years,[121] said: 'I would impress upon members, more particularly our Indian members, for whom the Institution was primarily founded, the necessity, and advantage, of submitting papers, on subjects with which they are most conversant'.[122] E.H. de Vere Atkinson (President 1929-30) acknowledged that 'this is the country of the Indian', although he qualified his support for Indianisation by saying that it should proceed 'on the right lines': an engineer must not be selected to a post unless he was competent to occupy it.[123] Atkinson's words appear to reflect, albeit mildly, contemporary British reservations about the suitability of Indian engineers for responsible work (these attitudes and the reasons behind them are discussed in Chapters 4 and 5).

In contrast, a mildly nationalistic note was struck by an Indian President, Jwala Prasad (1931-2), a Roorkee alumnus who had become Chief Engineer in the United Provinces PWD some years before:[124] 'An earlier predecessor and that an original founder stated on a similar occasion that this Institution was primarily meant for Indians. By this I think he did not mean an engineer in India but an Indian engineer. As I belong to this category it is but natural that my sentiments and opinions but follow the trend of the blood in my veins.'[125] Drawing attention to the Hindu epics and to recent archaeological discoveries, Prasad argued that ancient India had a rich history of engineering. He referred to

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[119] Hugh W. Brady, 'The Origin, Character and Prospects of the Institution', IEI *Journal*, Vol. 1 (September 1921), pp. 30-37, here p. 37.
[120] IEI *Journal*, Vol. XVIII (August 1938), p. 10.
[121] In Vols. VII (1927), VIII (1929) and IX (1930), only three papers each were published in the Institution's *Journal*.
[122] Address by W.H. Neilson, IEI President (1926-7), IEI *Journal*, Vol. VII (December 1927), pp. 9-24, here p. 9.
[123] Presidential Address by Lieut.-Genl. Sir Edwin H. de Vere Atkinson (President, 1930), IEI *Journal*, Vol. X (May 1931), pp. 10-16, here p. 11.
[124] Record of Services, *India Office List* for 1938.
[125] Presidential Address by Jwala Prasad, IEI *Journal*, Vol. XII (July 1933), pp. 19-23, here p. 19.

> the construction of the famous bridge over the sea at Cape Comorin … the flying of Rama to Ajodhya in a single day after the conquest of Lanka to save his devoted brother Bharat … the cutting of the Gangotri from a wonderful glacier through disinfecting rocks and land by [Rama's] great ancestor Bhagirath, before men knew how to dig a well. Some people dismiss these ideas with a sneer but be it remembered that our ancestors had a great reputation both for imaginative construction and veracity, that the Romans, whose remarkable works still remain, acknowledge their kinship with Indian culture and that the diggings at Sarnath, [Mohenjodaro] and other places cannot otherwise be accounted for.[126]

The other recurring theme in the IEI's discussions was Indian industrialisation. This reflected one of the institution's other goals: to encourage industrial engineers. While traditional areas like civil/ public works engineering continued to receive attention, papers discussed at the Institution's meetings were not limited to these fields, but included a range of industrial topics too (see Table 3.6 below).

Table 3.6: *Titles of some papers discussed at the IEI's meetings*

Author(s)	**Title of Paper**	**Details of publication in IEI *Journal***
A.R. Beattie	The B.T.U. in an Indian Paper Mill	Vol. XV (July 1935)
Goverdhan	Cooling Water for Diesel Engines	Vol. XV (July 1935)
J.W. Meares	The Possibility of Flood Regulation and Conservation in the Himalayas for Irrigation or Power	Vol. XV (July 1935)
M.L. Garga	Design and Construction of Tinai Nadi Aqueduct (Sarda Canal)	Vol. XVIII (August 1938)
M.S. Bhandarkar and Prof. K. Aston	Electrical Manufacturing Industry in India and the Scope and Line of its Future Growth	Vol. XX (January 1941)
Dr. M.A. Korni	Rontgenology in Reinforced Concrete	Vol. XX (January 1941)

Several Presidents, including some who were senior government officers, deplored the traditional mindset of engineers who set their minds on government jobs instead of working in private industry. In his presidential address for 1929-30, Edwin Atkinson held up the former President R.N. Mookerjee as an exemplar of the industrial engineer. 'I fear', he said, 'that even to-day every Engineering student looks forward only to Government employment … It is by

[126] *Ibid.*, p. 22.

private initiative that the Engineering profession can best foster the industrial prosperity of India.'[127] Fakirjee E. Bharucha (MIMechE, MIE [Ind.], IEI President 1937-8), who, beginning in the Bombay textile industry, had spent his working life as a mechanical engineer, devoted his address to a discussion of the state of mechanical (and by extension industrial) engineering in the country. Fifty years ago, he said, mechanical engineering had been seen as an occupation for 'those young men who were dunces and backward in their scholastic career …, as they were considered unfit for the so-called noble professions of law, medicine and civil engineering.' Such '[a]ristocratic prejudice' notwithstanding, Bharucha argued, mechanical engineering, by virtue of its close connection with industry, had become 'the most important branch of engineering without which no civilized country could thrive and have a place of honour in this world.'[128] Mechanical engineering was no more restricted to 'the upkeep of prime movers of factories or management of mechanic shops'; there was now a need for 'scientifically trained engineers' who could also design, manufacture and maintain the machinery in use in factories.[129] Unfortunately, the education system was not geared towards producing industrial engineers.[130]

Some Indian office-bearers pursued the theme of industrial development in more emphatic, sometimes nationalistic, terms. In the late 1930s, M.C. Bijawat, an irrigation engineer and Chairman of the United Provinces Centre of the IEI, drew a connection between personal courage and the pursuit of industrial engineering. Government jobs in engineering were scarce, he said, and 'it is a pitiable sight indeed to find a handful of products of a few Engineering Colleges begging from door to door for employment.' Engineers

> must no longer hanker after Government services, a hankering which exercises a very cramping effect on the intellectual development of the students and roots out their self-reliance. They should take up the line in a truly professional spirit which will give full scope for the exercise of their creative genius and to develop their initiative, they must learn to put the knowledge they have gained in their colleges to practical use in furthering research in all branches of the profession and help in making new discoveries and inventions … They will thus not only find employment for themselves, but will be able to create it for millions of other people ...[131]

[127] Presidential Address by Lieut.-Genl. Sir Edwin H. de Vere Atkinson (President, 1930), IEI *Journal*, Vol. X (May 1931), pp. 10-16, here p. 11.
[128] 'Presidential Address by Mr. Fakirjee E. Bharucha', p. 17.
[129] *Ibid*., p. 24.
[130] *Ibid*., pp. 27-8.
[131] Address of M.C. Bijawat, Chairman of the United Provinces Centre of the IEI, in IEI *Journal*, Vol. XVIII (August 1938), pp. 46-54, here pp. 53-4.

Although the politics of IEI members varied, the discourse on industrialisation became closely linked with economic nationalism, particularly from the late 1930s. The historian Gyan Prakash, writing on the link between the colonial state's use of technology and the growth of nationalism, has argued that '[w]hat began as an effort to relocate colonial power in technical apparatuses and practices unleashed a political struggle to establish a nation-state that would institute the logic of rational artifice more fully and efficiently.'[132] In a similar way, Indian engineers, while still operating within the colonial economy and state institutions, felt that through industrialisation they could play an important role in the making of a self-reliant India. C.V. Krishnasawami Chetty (AMIEE, MIE [Ind.]), Chairman of the South India Centre of the IEI, said in 1939 that since the outbreak of the war [World War II] Indians had been made aware of 'their utter dependence on other countries for most of their daily wants. It has opened the eyes of the people to the urgent necessity for starting various industries and especially key-industries [sic]. If the impetus now given to industrialization is not taken advantage of, I am afraid, India will ever be dependent on other countries for most of her wants [except] food.'[133] Referring to the National Planning Committee (set up under the aegis of the Indian National Congress, which then led a large number of provincial governments, in anticipation of political autonomy at the national level), Krishnaswami Chetty declared that the IEI must offer its support. 'Our Institution must place at the disposal of the National Planning Committee all the techincal [sic] assistance it can give. Our Institution must play an important part in the industrialization of the country… Time has come for engineers to evince greater interest and take part in the political life of the country.'[134]

The cause of Swadeshi [indigenous] industry and materials was also taken up. Fakirjee Bharucha insisted in 1938 that 'there is no sense in sending our raw materials to be manufactured into finished articles for us in foreign lands, when we could do it ourselves.'[135] In the Annual General Meeting of 1945, S.B. Joshi proposed a resolution advocating the use and manufacture of 'SWADESHI material, plant and equipment, without regard to cost and quality, with a view to advancing the Science of Engineering in India.'[136] When other members suggested that the clause 'without regard to cost and quality' be amended, Joshi argued that this would render the resolution meaningless; he was specifically suggesting that engineers buy Indian material even when it was *not* the most economic alternative. After all, it went without

[132] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton: Princeton University Press, 1999), p. 199.
[133] Address by Rao Bahadur C.V. Krishnaswami Chetty (Chairman, South India Centre) on 2 December 1939, in IEI *Journal*, Vol. XX (January 1941), pp. 87-91, here p. 89.
[134] *Ibid*., p. 90.
[135] 'Presidential Address by Mr. Fakirjee E. Bharucha', p. 29.
[136] IEI *Journal*, Vol. XXVI, No. 2, Part 2 (December 1945), p. 32.

saying that if the quality was sufficient, engineers should buy Indian. Anyone who did not 'is not an Indian, he is an enemy.'[137]

Conclusions

This chapter has identified several key transformations occurring in the engineering profession in India over the period 1900-47. Over this period, the model of a profession dominated by government-officer engineers in the public works, railways and military was altered considerably, as engineering activity expanded and diversified to include mechanical and electrical engineers working in large-scale industry. Equally importantly, the racial composition of its practitioners had undergone a substantial shift. The profession, dominated by expatriate British engineers in the nineteenth century, included an increasing proportion of 'native' Indians in the twentieth. These transformations should be seen as a part of the evolution of the economic and political relationship between Britain and India after World War I, when industrialisation and Indianisation became important items of government policy. As this chapter has shown, the development of professional institutions reflected these changes, and offers a fruitful means of documenting and understanding them.

An equally important, and related, transformation occurred in the identities that engineers in India fashioned for themselves. Membership of the London institutions, especially in the long nineteenth century, was a mark of belonging to a wider imperial, or international, engineering community. But the formation of the Institution of Engineers (India) in Calcutta in 1920 represented the beginnings of the idea of an Indian profession independent of the metropolis. Like the London Institutions did for the British profession, the IEI monitored the qualifications, performance and conduct of its members, while providing a forum for them to exchange ideas on technical topics and matters relating to the profession. Both Europeans and Indians working in India joined the IEI, and some of them were also members of the London Institutions; but the IEI's focus was on matters pertaining to India. In particular, it encouraged industrialisation and Indianisation in the profession. It offered qualifications equivalent to degrees for practitioners who had not been formally trained, afforded its corporate members recognition through the title of Chartered Engineer (India), and represented India in imperial and international forums. Although the Institution, as the brainchild of a government-appointed Commission, represented a top-down approach to creating an Indian profession, the Indian identity acquired a momentum of its own within the Institution's framework. This was reflected

[137] *Ibid.*, p. 33.

in the rhetoric of the IEI's office-bearers, both European and Indian, which included increasingly confident expressions of Indian ability, and in which a form of economic nationalism became visible from the late 1930s.

However, it should not be concluded from this story that the new Indian identity emerged uncontested. It was opposed vigorously in the beginning by the PWD Engineering Congresses operating in various provinces, which held a more exclusive vision for the engineering profession, centred on civil engineering, government-officer status, and the (hoped-for) approval of the Institution of Civil Engineers in London. Again, it would be simplistic and inaccurate to view this as a conflict between the votaries of colonialism and nationalism. In fact, the emergence of the IEI as the more prominent representative of Indian engineering was due not only to its inclusiveness but also to the endorsement it received from the colonial state—a state whose nature and priorities were undergoing important changes in the interwar period. The study of practitioners, their aspirations, goals and identities thus demonstrates that the history of science and technology in India needs to be understood as an integral part of Indian history.

CHAPTER 4

'British integrity, resource and impartiality'

Indianisation and the culture of public works engineering

Introduction

This chapter examines the working culture and organisation of the engineering services of the Indian Public Works Department (PWD) in the period 1900-40. Established in 1854, the PWD was one of the most important departments of the colonial government, engaged in the construction and maintenance of roads, bridges, buildings and irrigation works.[1] Its engineer officers, organised into large all-India and provincial bureaucracies (or 'services'), were at the executive and administrative heart of the Department, and were employed in substantial numbers (the all-India engineers alone numbered around 675 in 1929).[2] In the years 1900-40, growing demands for Indianisation and the introduction of the principle of provincial autonomy necessitated a rethinking of how the PWD's engineering services should be organised. The chapter demonstrates that while policymakers in Britain and in India recognised that reorganisation was required, they sought to upset as little as possible the existing culture of the engineering services. I will show that their debates and decisions revealed prevailing ideas of the qualities required of the ideal public works engineer.

Despite their importance, public works engineers in twentieth century India—and their bureaucratic organisation within the PWD—feature only occasionally in historical accounts of science and technology in India. Gyan Prakash, for instance, stresses the role of public works projects in the entrenchment of the colonial state in the nineteenth century, but does not focus

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[1] For a nineteenth-century description of the functions of the PWD, see C.D. Maclean (ed.), *Manual of the Administration of the Madras Presidency: In Illustration of the Records of Government & the Yearly Administration Reports* (reprint, 3 vols., New Delhi: Asian Educational Services, 1987 [1885-93]), vol. 1, p. 365ff. As mentioned in Chapter 3, the state-run railways also came under the PWD until 1905. The present-day Central Public Works Department of India gives 1854 as the date when the central government first had a 'Secretary of the Department of Public works'. See paragraph 13 of 'History of C.P.W.D.', document available under the tab 'Organisation'→'Historical Background' at http://cpwd.gov.in (accessed 21 July 2012).

[2] Estimate based on lists of officers of the Indian Service of Engineers in the *India Office List* for 1929. The source lists separately the officers posted in each province/presidency. In addition, there was a lower service of engineers employed by the respective provinces, whose combined strength would have been several hundred more (based on K.V. Mital's history of the Roorkee Engineering College, cited later in this chapter).

on the engineers who built and maintained those works.[3] Others have studied the relationship between engineering education and the PWD. Arun Kumar argues that the development of the Indian engineering colleges from 1847-1947 was controlled (and constrained) by the requirements of the PWD, while John Black focuses on the influence of the military on the PWD and its associated engineering colleges in India and Britain (again a study primarily of the nineteenth century).[4] Although it also deals with the long nineteenth century, David Gilmartin's study of 'colonialism and irrigation technology' in Sind is more directly concerned with working engineers and their ideology. Gilmartin argues that in the decades after the 1880s (when a network of irrigation canals was constructed in Sind), the engineering solutions ('imperial science') of irrigation engineers came into conflict with, and were checked by, civil administrators' 'science of empire', a theory of good governance that took into account notions of local community, custom and hereditary rights.[5] A different period is addressed in Daniel Klingensmith's study of dams and the discourse of development in India and the USA, which devotes a chapter to the ideologies of two prominent practitioners of 'nationalist engineering' in the late- and post-colonial India of the 1940s and '50s.[6]

Overall, however, there is no detailed account of the internal structure of the PWD (which was essentially made up of engineers and engineering subordinates[7]), or how it was affected by interwar constitutional changes in India. This historiographical neglect of the PWD's engineering service contrasts with the study of other government services. The Indian Civil Service (ICS), its modes of recruitment and the attitudes and worldviews of its officers

[3] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton: Princeton University Press, 1999), Chapter 6.

[4] Arun Kumar, 'Colonial Requirements and Engineering Education: The Public Works Department, 1847-1947' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995), pp. 216-232; John Black, 'The military influence on engineering education in Britain and India, 1848–1906', *The Indian Economic and Social History Review*, 46, 2 (2009), pp. 211–239. Technical education is also dealt with in Aparna Basu, 'Technical Education in India, 1854-1921', in Aparna Basu, *Essays in the History of Indian Education* (New Delhi: Concept, 1982), pp. 39-59 and Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York and Oxford: Oxford University Press, 1988), Chapter 9.

[5] David Gilmartin, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', *The Journal of Asian Studies*, Vol. 53, No. 4 (November 1994), pp. 1127-49.

[6] Daniel Klingensmith, *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007), Chapter 5.

[7] E.g. see the PWD listing for Madras Presidency, *India Office List* for 1924, p. 35, and the more detailed listing for the PWD in that presidency in 1922: Govt of Madras, PWD, *Classified List and Distribution Return of Establishment, corrected up to 30th June 1922* (Madras: Superintendent, Government Press, 1922), APAC: IOR/V/13/831. (APAC refers to the Asia Pacific and Africa Collection, British Library, London.)

have been a particularly fertile field of historical research,[8] while the Indian Medical Service (IMS) in the long nineteenth century and the scientific services of the government in the interwar years have also received historical attention.[9]

Using a range of sources including government service lists, official reports, published and manuscript memoirs of individual engineers, and British parliamentary debates, I explore the following questions in this chapter. What functions was the typical engineer-bureaucrat in the PWD expected to carry out? How did the training of engineers and systems of recruitment relate to the bureaucratic structure of the PWD, and how did these systems change over time in response to the progressive transfer of administrative power from appointed colonial officials to elected Indian ministers in the provinces?

The chapter is divided into two main sections. Starting in 1900, when the PWD was dominated by Europeans, and extending to the outbreak of World War II, when Indians made up more than 50 per cent of its elite engineering service, the first section describes the changing patterns of training, recruitment and organisation of PWD engineers. The second section seeks to explain some of these changes, and officials' response to them, in relation to the culture and functions of PWD engineering. It reveals that British officials and policymakers perceived the ideal engineer as a generalist and a gentleman, and shows how this idea operated to limit the extent of Indianisation and the reorganisation of the PWD. Consequently, engineers continued to be recruited in Britain until at least 1935 despite the fact that a career in India had by then become less attractive to Britons.

Recruitment, constitutional change and reorganisation

The Imperial and Provincial Services, 1900-20

In 1900, the Public Works Department was a department of the Government of India with its own secretariat at the centre and a member of the Viceroy's Council at the helm. Under him were Secretaries and Under-Secretaries to government, consulting engineers or advisers to government, and Inspectors of engineering. The actual work of the PWD was done in the

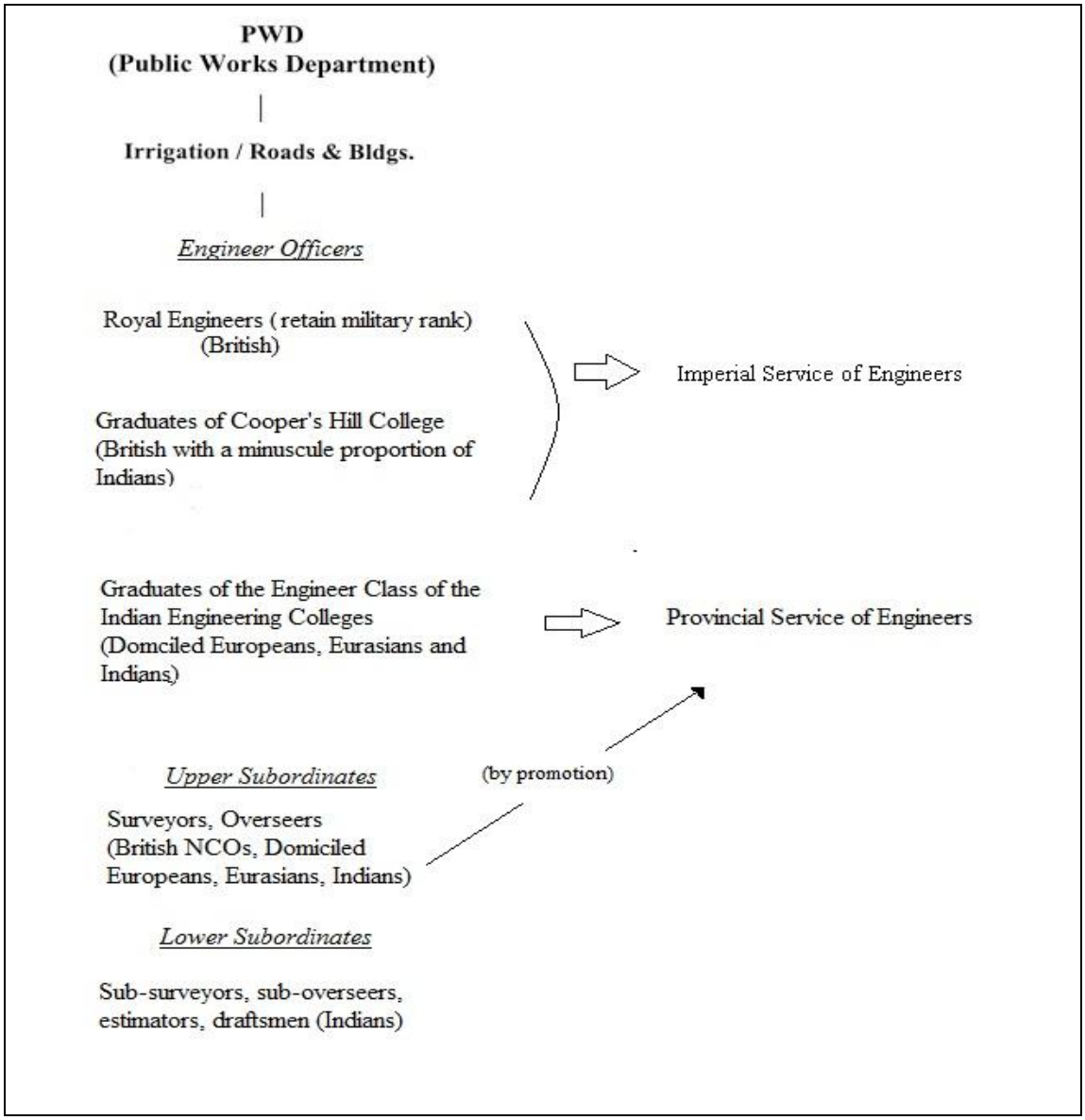
[8] On the ICS see David C. Potter, *India's Political Administrators 1919-1983* (Oxford: Clarendon, 1986); C.J. Dewey, 'The Education of a Ruling Caste: The Indian Civil Service in the Era of Competitive Examination', *The English Historical Review*, Vol. 88, No. 347 (April 1973), pp. 262-285; Maria Misra, 'Colonial officers and gentlemen: the British Empire and the globalization of "tradition"', *Journal of Global History*, Vol. 3, Issue 2 (July 2008), pp. 135-161.

[9] On the IMS see Mark Harrison, *Public Health in British India: Anglo-Indian Preventive Medicine 1859-1914* (Cambridge, New York and Melbourne: Cambridge University Press, 1994). For the scientific services see David Arnold, *Science, Technology and Medicine in Colonial India (The New Cambridge History of India* Vol. III.5) (Cambridge: Cambridge University Press, 2000), Chapter 5.

provinces, each of which had its own PWD secretariat headed by one or more Chief Engineers. Most provincial PWDs were further divided into two branches: Roads & Buildings, and Irrigation.[10] The structure of the PWD in each province as of 1900, along with the system of recruiting engineers at different levels, is summarised in Figure 4.1.

[10] Based on Government of India, PWD, *Classified List of Establishment* for various years. Available in APAC, Shelfmarks in the series IOR/V/13. See also *India Office List* for various years.

Figure 4.1: *PWD organisation and recruitment at 1900* [11]



[11] This reconstruction of the structure of the PWD is based on various sources, for instance Brendan P. Cuddy, 'The Royal Indian Engineering College, Cooper's Hill, (1871-1906): A case study of State involvement in professional civil engineering education' (PhD thesis, London University, 1980); C.D. Maclean (ed.), *Manual of the Administration of the Madras Presidency: In Illustration of the Records of Government & the Yearly Administration Reports* (reprint, 3 vols., New Delhi: Asian Educational Services, 1987 [1885-93]), vol. 1, especially p. 368; and Arun Kumar, 'Colonial Requirements'.

As the figure shows, the engineer officers of the PWD were divided into two services, the Imperial Service of Engineers, whose members were recruited in Britain; and the Provincial Service of Engineers, its members recruited in India. Members of a service were subject to a common set of rules regarding pay, leave and promotion, irrespective of their physical location (the work of an engineer, whether Imperial or Provincial, lay in the province where he was posted). The main distinction between the Imperial and Provincial Services lay in these terms and conditions, not in the nature of work or the ranks that they could attain.[12] Engineers of the Imperial Service enjoyed higher pay, more favourable leave arrangements, and also greater prestige than their Provincial counterparts (more on this below).

Recruitment to the Imperial Service of Engineers was controlled by the Secretary of State for India, based at the India Office in Whitehall.[13] There were two main sources of manpower, each supplying a fixed quota of engineers annually. The first of these was the military in Britain: six Royal Engineers, trained in the military engineering colleges of Addiscombe, Woolwich and Chatham, were selected annually for the PWD. These men, who retained their military rank and privileges, represented the continuation of a tradition: public works in the early years of the PWD (and before its founding) had been carried out mainly by military officers. Their continuing employment in civil positions was not confined to the PWD, but extended also to the state railways, as Chapter 5 will show.

The second source of engineers for the Imperial Service was the Royal Indian Engineering College (RIEC) at Cooper's Hill, from which 15 graduates were selected annually. This college had been set up in 1871 for the express purpose of satisfying the Indian PWD's demand for engineers, and its expenses were borne by the Government of India. The RIEC admitted students on the basis of an entrance examination that tested them on English, mathematics, Latin, Greek, French, German, natural and experimental sciences, and mechanical and freehand drawing (English and the other languages made up close to 50 per cent of the total marks). The curriculum at the College itself included Engineering, Mathematics, Natural

[12] *Royal Commission on the Public Services in India. Report of the Commissioners*, Vol. I (Cd. 8382, London: HMSO, 1917), p. 19 (paragraph 25). This report is hereinafter cited as *Islington Commission Report*.

[13] The following paragraphs on the sources of recruitment is based on the following works (except when another source is specifically cited): Arun Kumar, 'Colonial Requirements', especially p. 228; Cuddy, 'Royal Indian Engineering College', esp. Chapter 2 and pp. 147-8; K.V. Mital, *History of the Thomason College of Engineering (1847-1949): On which is Founded the University of Roorkee* (Roorkee: University of Roorkee, 1986), p. 78; Headrick, *Tentacles of Progress*, Chapter 9; Annexure XVIII: 'Public Works Department and Railway Department (Engineering Establishment)', *Islington Commission Report*, pp. 326-37, esp. p. 329; Hirday Nath Kunzru, *The Public Services in India (Political Pamphlets—II)* (Allahabad: Servants of India Society, 1917), p. 146.

Science, Language (including Hindustani), and a period of apprenticeship to a practising engineer. Students were also instructed in the History and Geography of India.

This system of recruitment meant that the Imperial Service of Engineers was almost entirely made up of Britons, the only exception being a select few Indians who could afford to travel to England and study at Cooper's Hill. By a rough estimate, Indians constituted well under 5 per cent of the graduates of Cooper's Hill over the duration of the College's existence.[14]

The Provincial Service, on the other hand, was composed of Europeans domiciled in India, Eurasians, and Indians. Indeed its creation in 1895 had been advertised as a means for granting greater opportunities for Indian engineers to join the PWD. Engineering officers were recruited from the Engineer Class of the Indian engineering colleges at Roorkee, Madras, Poona and Sibpur near Calcutta. These had been established from the mid- to late-nineteenth century, and also ran classes for Upper and Lower Subordinates, whose graduates joined the PWD at the corresponding subordinate levels. Nine and ten engineers in alternate years were appointed to the Provincial Service, the largest share coming from the oldest of the Indian colleges, Roorkee's Thomason College of Engineering. In addition to this, five and four Upper Subordinates were promoted to the Provincial Service of Engineers in alternate years (i.e., in a given year the total number of appointments to the Provincial Service was 14).

The hierarchical organisation within the PWD in each province was as follows. The province was divided into geographical areas of responsibility called circles, divisions and sub-divisions (in decreasing order of area). The lowest rank in either Service (Imperial or Provincial) was Assistant Engineer (AE), responsible for a sub-division. Executive Engineers (EE), the next higher rank, were placed in charge of a division. Above this were the two 'administrative' ranks, their main functions being supervisory. These were Superintending Engineer (SE, in charge of a circle) and Chief Engineer (CE). There were usually one or two Chief Engineers in a province, one in charge of the Roads and Buildings branch for the whole province, and the other heading Irrigation.[15]

This system of recruiting for the PWD by patronage given to specific colleges and the Royal Engineer Corps was quite unlike the competitive examination system used for the Indian Civil Service.[16] It was also under strain. The Cooper's Hill College was in a precarious position at the turn of the twentieth century. In spite of the high fees it charged its students, it was not

[14] This estimate is based on Appendix C: 'Students of the R.I.E.C.' in Cuddy, 'Royal Indian Engineering College', pp. 310-37. The uncertainty is primarily due to the difficulty of distinguishing some Anglo-Indian names from European names.

[15] Annexure XVIII: 'Public Works and Railway (Engineering) Departments', *Islington Commission Report*, p. 326 (paragraph 2); *Ibid.*, pp. 332-3 for the usage of the term 'administrative grades'; PWD *Classified Lists*.

[16] For more on the systems of competitive examinations and nomination/patronage, see Chapter 2 above.

financially self-sustaining—a fact that was resented by the Government of India, which bore its expenses and against whose initial wishes the College had been set up. The College also faced opposition from other British colleges and universities that had developed degree-level courses in engineering in the latter half of the nineteenth century. These institutions argued that their students should be eligible for appointment to the PWD. Matters came to a head when the RIEC's last President, in a desperate attempt to reduce costs, summarily dismissed several long-serving faculty members. The Board of Visitors conducted an inquiry, and in 1904 the Secretary of State's Council of India voted for the abolition of the college. It was finally closed in 1906.[17]

The abolition of the RIEC did not mean an increase in recruitment from the Indian engineering colleges. Instead, the India Office continued to recruit civil engineers in England, turning now to the colleges that had earlier opposed the RIEC's monopoly. Men between the ages of 21 and 24 who had either obtained one of a specified list of British engineering degrees or passed the Associate Membership examination of the Institution of Civil Engineers were eligible to apply for recruitment in London. These qualifications included the B.Sc. (Engineering) courses in the Universities of London, Glasgow and Edinburgh; Sheffield's B.E.; Liverpool's B.Eng.; and Cambridge's B.A. Honours (Mechanical Sciences Tripos). Candidates would be interviewed at the India Office and their suitability in terms of health, riding ability and 'moral character' assessed. Those selected would be appointed to the post of Assistant Engineer in the Imperial Service of Engineers and posted to one of the Indian provinces.[18] As of 1912, the Selection Committee was made up of one member of the Secretary of State's Council of India and two engineers, one of whom was a nominee of the Institution of Civil Engineers (which, as Chapter 3 showed, was the most important of the London institutions for British expatriate engineers in India prior to World War I).[19]

Thus recruitment in Britain for the Imperial Service continued despite the closure of Cooper's Hill. In fact the number of London recruits now went up, the annual average being 30 between 1909 and 1914.[20] As in the Cooper's Hill days, Indians could apply for Imperial Service positions, but would 'be selected to the [maximum] extent of 10 per cent.' of the India Office recruits in a given year, 'if duly qualified.' Outside of this 10 per cent limit, '[e]very Candidate…must be a British subject of European descent, and at the time of his birth his father must have been a British subject, either natural-born or naturalised in the United Kingdom.'[21]

[17] Cuddy, 'Royal Indian Engineering College', pp. 265-292.
[18] See 'Indian Public Works Department. Regulations as to Appointments of Assistant Engineers, 1910' and Appendix I in the *India Office List* for 1910, p. 222 and p. 223.
[19] Annexure XVIII, *Islington Commission Report*, p. 330.
[20] Kunzru, *Public Services in India*, p. 148.
[21] 'Regulations as to Appointments of Assistant Engineers, 1910', *India Office List* for 1910, p. 222.

As is apparent from this, only a very small number of Indians were recruited in London—their number was 3 in 1909.[22]

The sanctioned strengths of the Provincial and Imperial Service were approximately in the ratio of 3:7.[23] Yet it appears that the proportion of Provincial engineers was in practice even lower. A government report showed that in 1913, statutory Indians constituted 18.5 per cent of posts in the PWD with a salary of Rs. 500 per month and above. As engineers below this salary level were more likely to be members of the Provincial Service than of the Imperial Service, this calculation probably underestimates the percentage of Indians. Yet, even accounting for this, it seems unlikely that the strength of the Provincial Service (to which most Indian engineers belonged) constituted thirty per cent of PWD engineers at this stage.[24]

Reorganisation of the engineering services, c. 1920-40

In the interwar period, several changes were made in the structure of the engineering services. This process was driven by three main factors. First, the difference in prestige and terms of employment between Imperial and Provincial engineers caused dissatisfaction in the latter group. Second, there was a growing political demand for Indianisation in the public services, which was very relevant to the engineering services given their low percentage of Indians (see above). Third, there were the constitutional reforms of 1919 and 1935. As described in Chapter 2, these reforms altered the relationship between the PWD and the central and provincial governments, necessitating a corresponding restructuring of the engineering services.

Provincial Service engineers were dissatisfied by distinctions in salary within the PWD, which meant that they received roughly two-thirds the salary of their Imperial counterparts (except at Chief Engineer rank, where salaries were equal).[25] The distinction in salaries between statutory Indians and Europeans was common to most services, and justified by officials on the grounds of 'the cost of production of a European officer in Europe'. It was argued that 'no European will serve away from his own country without an exceptional inducement',[26] while paying Indians more than 'what is required to obtain suitable Indian officers' would 'impose for

[22] Reply of the Master of Elibank, Under-Secretary for India, to Dr. Rutherford, House of Commons Debate, 30 September 1909, Vol. 11, cc. 1421-2 (Hansard): 'Indian Public Works Department (Assistant Engineers)'. This and all British parliamentary debates hereinafter cited (unless otherwise specified) were accessed via http://hansard.millbanksystems.com/.
[23] See Annexure XVIII, *Islington Commission Report*, p. 328 (paragraph 8).
[24] See table in *Islington Commission Report*, p. 25. The figure of 18.5 per cent is calculated for 'Indian and Burmans' and 'Anglo-Indians' combined. On the salaries, see *Historical Retrospect of Conditions of Service in the Indian Public Works Department. (All India Service of Engineers)*, Private pamphlet (c. 1925) in the Secretary of State's Library Pamphlets, Vol. 72, T.724 (APAC: P/T724), p. 8.
[25] *Historical Retrospect of Conditions of Service*, p. 2 and p. 8.
[26] *Islington Commission Report*, p. 38.

all time on the country a burden which she ought not to bear.'[27] The salaries (in Rupees) of PWD engineers at various ranks until 1908 were as follows:

Table 4.1: *Salary scales (in Rupees) of PWD engineers, 1892-1908*

Period	Type of Service	Assistant Engineer	Executive Engineer	Superintending Engineer	Chief Engineer
1892-1908	Imperial	350—550	700—1,000	1,250—1,600	1,800—2,500
	Provincial	250—400	475—650	750—1,050	1,800—2,500

Source: *Historical Retrospect of Conditions of Service in the Indian Public Works Department. (All India Service of Engineers)*, Private pamphlet (c. 1925) in the Secretary of State's Library Pamphlets, Vol. 72, T.724 (available in APAC: P/T724), p. 8.

The status of the Provincial engineers was another source of dissatisfaction. As explained in an earlier chapter, the term 'provincial' in most government services (such as the civil service) referred to officers who were given a lower grade of tasks, and could never attain the higher positions allotted to the Service. This association of the term with a lower status affected the Provincial engineers too, although they performed the same range of functions as Imperial engineers, and indeed could attain the same ranks (including that of Chief Engineer).[28]

The Provincial Service of Engineers had originally been created for a limited period of time, which came to an end around 1906. Hopes were raised for a more equitable system, and Provincial engineers (or their representatives) submitted a memorial to the government asking for the Provincial Service to be dissolved. They were disappointed.[29] Although questions about the unequal system were raised in the British Parliament by MPs sympathetic to the Indian/ Provincial Service engineers, the Secretary of State Morley refused to change the 'general rule of the public service in India that officers recruited in India, whether Indians or Europeans, are on a different footing as regards pay, leave, and pension from those who are recruited in

[27] *Ibid.*, p. 37.
[28] *Ibid.*, p. 19 (paragraph 25). A few Provincial Service engineers had reached the highest ranks in 1912, when 3 Chief Engineers out of 13 were alumni of the Indian engineering colleges (i.e. members of the Provincial Service). The number for Superintending Engineers was 21 out of 71. Calculated from Government of India, Public Works Department, *Classified List and Distribution of Establishment, corrected up to 30th June 1912* (Calcutta: Superintendent Government Printing, India, 1912). APAC: IOR/V/13/216. In this and all following statistics from *Classified Lists*, numbers for each rank include temporary or officiating rank holders.
[29] Kunzru, *Public Services in India*, p. 147.

England.'[30] In the reorganisation that followed in 1908, the gulf in status between the Provincial and Imperial Services widened: different promotion criteria were created for the Provincial Service. Its members would have to serve for fifteen years as Assistant Engineers before receiving the rank of Executive Engineer; for Imperial engineers the period was just eight years.[31] This prompted further dissatisfaction, the Labour MP James O' Grady suggesting in 1909 that the Imperial/Provincial distinction be done away with altogether.[32] Provincial engineers kept up their protests, and in 1912 the old system—whereby their normal rate of promotion was the same as that of Imperial engineers—was restored.[33]

Meanwhile, as we saw in Chapter 2, demands for the Indianisation of the public services were gathering momentum. The central and provincial legislative councils were expanded and partially Indianised in 1909; and the efforts of Indian legislators led to the appointment of the Islington Commission in 1912, to look into the Indianisation of the public services and the salary and benefits of public servants.[34] The Islington Commission's report, published in 1917, noted that despite the existence of two services in the PWD, 'the superior duties are performed by one class of superior officers, recruited on a single standard of qualifications.' Hence the Commission recommended that the Imperial and Provincial Services should be merged. 'In this way we should achieve an organisation of the services based on the work which they are required to do, and not on the race of, or the salaries drawn by, their members or any such artificial distinction.'[35]

This resulted in the most significant change in the PWD's organisation since the 1890s (when the Provincial Service had been created): in 1920 the Imperial and Provincial Services were replaced by a single Indian Service of Engineers (ISE).[36] Also on the recommendation of the Islington Commission, fresh recruitment to the ISE was made in the proportion of half and half in England and India respectively. While statutory Indians could still be selected by the

[30] Exchange between Mr. Hart-Davies and Secretary of State Morley, House of Commons Debate, 10 Feb 1908, vol. 183, c.1391 (Hansard): 'Appointments for Natives in Public Works Department, India'. Hart-Davies was Liberal MP for Hackney North. 'Members', House of Commons Parliamentary Papers (http://parlipapers.chadwyck.co.uk/fullrec/members.do?member=04266, accessed 14 July 2012).
[31] Kunzru, *Public Services in India*, p. 147; *Historical Retrospect of Conditions of Service*, p. 3; exchange between Thomas Hart-Davies and Thomas Buchanan, House of Commons Debate, 1 March 1909, Vol. 1, cc.1225-7W (Hansard): 'Indian Colleges (Imperial Service).'
[32] Exchange between Mr. O'Grady and Mr. Harold Baker, House of Commons Debate, 10 October 1912, vol. 42, cc.500-1 (Hansard): 'Provincial Engineers (India)'. James O'Grady was Labour member for Leeds East. 'Members', House of Commons Parliamentary Papers (http://parlipapers.chadwyck.co.uk/fullrec/members.do?member=05256, accessed 14 July 2012).
[33] Kunzru, *Public Services in India*, p. 147; *Historical Retrospect of Conditions of Service*, p. 3.
[34] *Islington Commission Report*, p. 2.
[35] *Islington Commission Report*, p. 19 (paragraph 26).
[36] Mital, *History of the Thomason College of Engineering*, p. 181 and p. 183.

Secretary of State, the 10 per cent quota for them in London was removed.[37] This 50-50 formula constituted the Commission's recommendation towards Indianising the PWD (they calculated that the earlier share of engineers recruited in India had been 37.5 per cent).[38] Engineers already serving were appointed retrospectively to the ISE. Pre-1920 Upper Subordinates could also be promoted to the ISE.[39] The strength of the newly created ISE may be estimated at about 700.[40]

Although the ISE had been created primarily to remove distinctions between engineers on the basis of race and place of recruitment, some persisted. Engineers from the Indian colleges were still identified as India-recruited ISE and were employed on different terms from the London recruits. For instance, engineers domiciled outside India (i.e. most of those recruited in London) received an additional overseas allowance.[41]

These changes were accompanied by another one, which, while increasing opportunities for India-trained engineers, perpetuated the two-tier system of engineer officers in the PWD. A new provincial service of engineers was created *for each province*. The existing Upper/Lower Subordinate branches were merged into one subordinate branch, and a large number of the erstwhile Upper Subordinates now populated the new provincial service (along with some direct recruits from the Indian engineering colleges). These men now occupied the rank of Assistant Engineer, and were placed in charge of some sub-divisions. The lowest rank in the ISE was renamed Assistant Executive Engineer.[42] This may be summarised as follows:

[37] Annexure XVIII, *Islington Commission Report*, p. 329.
[38] *Ibid.*, p. 328.
[39] See Figure 4.2 below.
[40] The sanctioned strength of Imperial and Provincial Services combined in the PWD at the time of the Islington Commission (c. 1915) was 728. Annexure XVIII, *Islington Commission Report*, p. 326. As explained below, steps were taken to reduce the number of engineers in the lowest rank of the ISE.
[41] PWD *Classified Lists*; *Historical Retrospect of Conditions of Service*, p. 4; see also *East India (Civil Services in India). Report of the Royal Commission on the Superior Civil Services in India* (Cmd. 2128, London: HMSO, 1924), pp. 30-1 on overseas pay for officers domiciled outside India. The last of these sources is hereinafter cited as *Lee Commission Report.*
[42] Mital, *History of the Thomason College*, p. 183; PWD *Classified Lists*.

ISE

Chief Engineer	(manages province posted to)
Superintending Engineer	(circle)
Executive Engineer	(division)
Assistant Executive Engineer	(sub-division)

New provincial service (in each province)

Assistant Engineer	(sub-division)

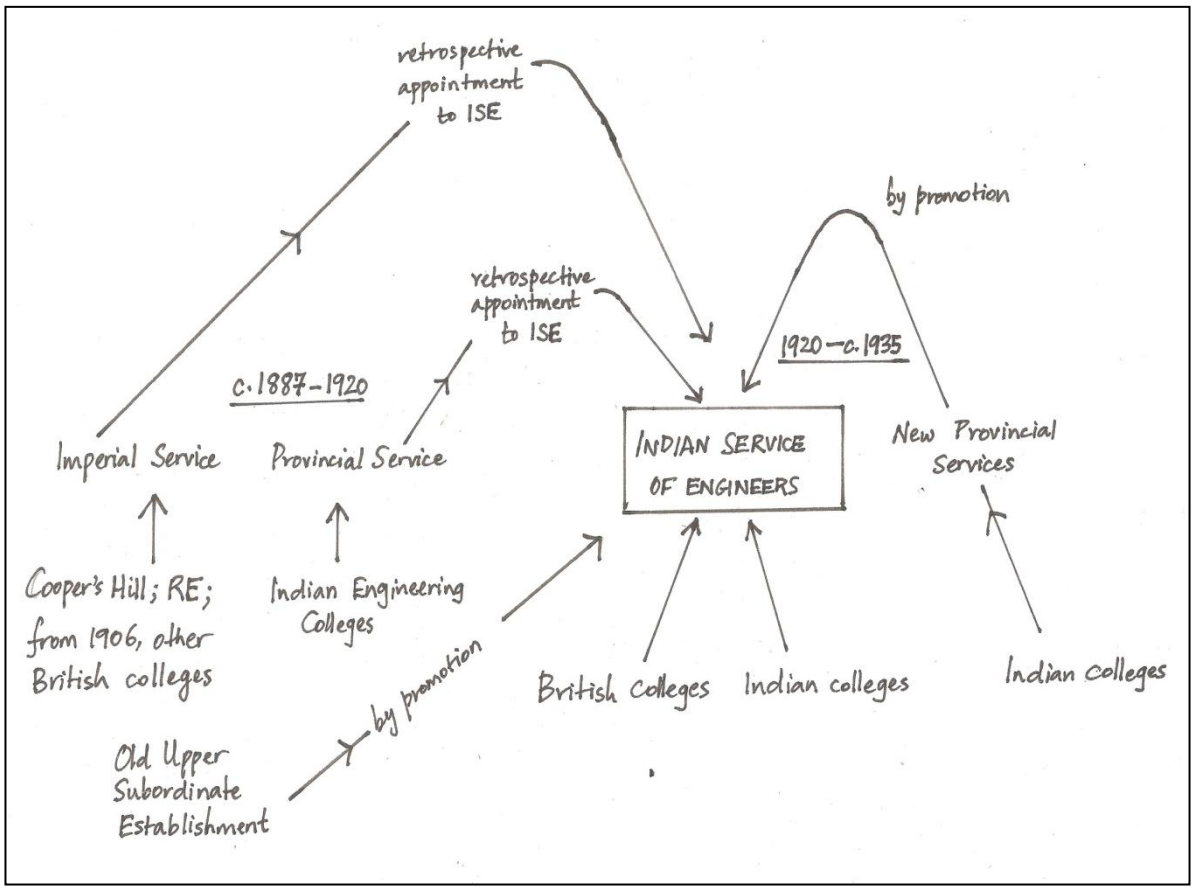
In proposing this change, the Islington Commission had reasoned that engineers entering the upper service (now the ISE) should not be kept at the lowest rank for an unduly long period, lest they should get bogged down in mundane tasks that did not make full use of their abilities. By converting the Upper Subordinate branch into a lower engineering service (with a corresponding increase in pay) whose members could be placed in charge of a certain number of sub-divisions, the number of engineers in the lowest rank of the ISE could be reduced, allowing for quicker promotions.[43]

The new provincial services were large: the historian of the Roorkee Engineering College gives their cumulative strength at their inception as 850.[44] This number is commensurate with official data for the Madras Provincial Service in 1922, which had 100 Assistant Engineers. Since these were mostly former upper subordinates or fresh graduates from the Indian colleges, virtually all of them would have been statutory Indians (i.e. Indians, Anglo-Indians, Domiciled Europeans). This is confirmed by the Madras list, in which 85 out of 100 Assistant Engineers bear recognisably Indian names—the remaining most likely Anglo-Indians and/or Domiciled Europeans.[45] These Assistant Engineers also had the prospect of promotion into the ISE ranks. [46]

The various paths into the ISE, through promotion and direct recruitment, are summarised in Figure 4.2.

[43] Annexure XVIII, *Islington Commission Report*, pp. 327-8.
[44] Mital, *History of the Thomason College*, p. 183.
[45] Government of Madras, PWD, *Classified List and Distribution Return of Establishment*, corrected up to 30th June 1922 (Madras: Superintendent, Government Press, 1922). APAC: IOR/V/13/831.
[46] See Figure 4.2.

Figure 4.2: *Routes into the ISE (direct recruitment and promotion)*[47]



Overall, there were increased opportunities for the graduates of the Indian engineering colleges. The patronage for Roorkee, for instance, was increased, guaranteeing appointments to the top nine or ten graduates of its engineering class annually in the ISE.[48] While even more opportunities were created for graduates of the Indian colleges in the new provincial services, it is arguable that the new Assistant Engineer position was essentially a renamed subordinate position (with some increase in pay and responsibility, but lower status than the ISE ranks).

Despite the increase in prospects for Indian engineers, Indian opinion was sharply critical of the Islington Commission's approach to Indianisation. One commentator felt that while the system of 50-50 recruitment was an improvement on the earlier opportunities for

[47] Constructed on the basis of official PWD *Classified List*s for various years.
[48] This guarantee to Roorkee continued until 1927. Mital, *History of the Thomason College*, p. 188.

Indians, the Commission had not adequately justified its premise that recruitment in Britain could not be abolished entirely. He quoted the evidence of the Secretary to Government of India for the PWD, who had said that 'no political considerations were involved' in selecting engineers for the department, and that the best trained engineers should be selected no matter where they came from; the Indian engineering colleges, on the other hand, were accepted, even by the Commission itself, as of sufficiently high standard. Such being the case, the Commission's vague statement that they were 'satisfied that there are grounds of policy for continuing to recruit from Europe as well as India' was unsatisfactory.[49]

The percentage of Indians in the ISE did increase under the 50-50 recruitment policy, albeit gradually—as one would expect, given the large size of the service relative to the annual number of recruits. In 1924, when it had been in operation for a few years, the overall proportion of Indians in the ISE was less than 30 per cent.[50] Indian politicians' dissatisfaction with the rate of Indianisation in the public services after World War I was noted, and the Lee Commission of 1923-4 was asked, among other things, to suggest measures for further Indianisation.[51]

Alongside its measures on Indianisation (discussed below), the Lee Commission also recommended an important change in the structure of the PWD's engineering services. This was made necessary by the introduction of dyarchy under the 1919 Government of India Act. As mentioned in Chapter 2, Roads and Buildings had now become a 'transferred' subject under the control of elected provincial ministers. To reflect this change, the Commission provincialised the corresponding branch of the ISE. This meant that no fresh recruitment would be carried out for the Roads and Buildings branch of the ISE (although the existing officers would continue): these posts would be filled, as vacancies arose, by the concerned provincial governments. Indianisation in this branch was therefore expected to proceed automatically, as the provincial governments would ordinarily recruit statutory Indians.[52]

For the Irrigation branch of the ISE, recruitment by the Secretary of State continued. The Lee Commission recommended that engineers for this branch be recruited in the ratio of 40

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[49] Kunzru, *Public Services in India*, pp. 148-50. The Islington Commission's words quoted here are from Annexure XVIII of its report, p. 328.

[50] *India Office List* for 1924. This estimate may be slightly on the low side, as only officers drawing Rs. 700 a month or more are listed, which means a number of Assistant Executive Engineers—half of whom were recruited in India—may not be accounted for.

[51] *Lee Commission Report*, pp. 5-6.

[52] In case European officers were required to be recruited in Britain for a provincialised service like Roads and Buildings, such recruitment would be carried out not by the Secretary of State but by the High Commissioner for India. See the reply of Earl Winterton, Under-Secretary of State for India, to Mr. Wallhead, in 'Head [sic] Commissioner for India', House of Commons Debate, 29 March 1926, vol. 193, cc. 1624-6 (Hansard), here c. 1625.

per cent Europeans, 40 per cent Indians, and 20 per cent Indians promoted from the provincial service. In the smaller provinces where the PWD was not divided into branches, the existing system of 50 per cent recruitment in England and 50 per cent in India was to be continued, while the old 10 per cent rule was reinstated (i.e. of those recruited in England, 10 per cent must be Indians).[53]

Over the following years, the provincialisation of Roads and Buildings led to a slow decrease in the size of the ISE, while the Indian quota in recruiting engineers for the Irrigation branch led to a gradual Indianisation of the Service. In 1928, Indians formed around 36 per cent of the ISE.[54] The process was accelerated when, following the Government of India Act of 1935, the PWD's Irrigation branch was also placed under elected ministers in the provinces, and fresh irrigation engineers recruited here rather than through the ISE.[55] Yet British parliamentarians resisted this move, and the Secretary of State reserved the right to appoint, in exceptional circumstances, anyone of his choosing to any public post related to Irrigation.[56]

With the PWD now entirely provincialised, the size of the ISE, as counted from the *India Office List*, decreased to about half its original size by 1940, when its strength was 369. Of these, 209, or 57 per cent, were Indians.[57] Indianisation had progressed considerably from the figure of 30 per cent a decade and a half earlier. This should be seen in the context of two contemporary factors which were outlined in Chapter 2. The first was that from around 1920, it was increasingly difficult to attract British recruits to the public services as a whole. Second, as the Lee Commission acknowledged, demands were increasingly being made in the Legislative Assembly and elsewhere for a more emphatic move towards Indianisation, including, for instance, transferring control of the All-India Services from the Secretary of State to the Government of India.[58] Despite this combination of factors, demands for far-reaching measures—such as recruiting only in India—were consistently held off until the 1935 Act came into force (and even then significant caveats were made). The government embarked upon Indianisation and provincialisation with considerable circumspection. The reasons for this were never declared overtly, beyond general formulations such as 'there are grounds of policy' (the Islington Commission). Yet, as I reveal in the next section, it is possible to discern some of the

[53] *Lee Commission Report*, pp. 21-2 (paragraph 40) and p. 65 (paragraph xvi).
[54] Calculated from *India Office List* for 1928.
[55] That is, all fresh recruitment for the ISE would now cease. See J.D. Shukla, *Indianisation of All-India Services and its Impact on Administration* (New Delhi: Allied Publishers, 1982), p. 335. See also Chapter 2 above.
[56] *Government of India Act, 1935* (26 Geo. 5, Ch. 2), paragraph 245 (p. 149). The debate on provincialising the Irrigation branch is discussed in detail in the section below.
[57] Calculated from *India Office List* for 1940.
[58] *Lee Commission Report*, p. 6; Reginald Coupland's Minute in *ibid.*, pp. 116-123, here p. 120 (paragraph 12).

reasons by analysing the culture of engineering in the PWD, and the sorts of characteristics that British officials and policymakers thought the ideal engineer should possess.

Defining the ideal PWD engineer

The engineer as gentleman and generalist

From c.1870 onwards, the India Office cast its India-bound engineers in a gentlemanly mould. As outlined above, applicants to the RIEC at Cooper's Hill were tested in classical languages and English history in addition to mathematics and natural sciences. Once admitted, students worked hard but also had a lifestyle involving billiards, wine and formal meals in Hall.[59] Col. Chesney, the first President of Cooper's Hill, was of the opinion that men selected to serve in the Indian PWD should be 'not only good engineers but religious men, at any rate Christians in feeling and profession',[60] and in 1878 a military officer on the North Bengal State Railway expressed the view 'that a better, abler and more gentlemanly set of men than the recently joined men from Coopers Hill could not have been sent out to India.'[61] Indeed these requirements were similar to the general characteristics prized by British officials in charge of selecting other types of colonial civil servant, such as members of the Indian Civil Service and its analogues in Malaya and Africa. As historians have shown, they valued pursuits such as riding and sport in candidates above mere intellectual prowess. Colonial service aspirants could be rejected for speaking with a Birmingham accent or selected on the strength of having been a Rugby Blue.[62]

Graduates of Cooper's Hill, who liked to talk of the '*esprit de corps*' in the Imperial Service that resulted from their years together in College,[63] had a formative influence on the culture of the PWD. Although the College was closed in 1906, its alumni dominated the upper echelons of the engineering services through to the 1930s, when the last batch of RIEC graduates came to the end of their careers. In 1912, RIEC alumni accounted for 9 out of 13 Chief Engineers (69 per cent) and 45 out of 71 Superintending Engineers (64 per cent), figures

[59] Cuddy, 'Royal Indian Engineering College', pp. 171-2.
[60] Quoted in Cuddy, 'Royal Indian Engineering College', p. 200.
[61] J.G.P. Cameron, *A Short History of the Royal Indian Engineering College: Coopers Hill* (n.p.: Coopers Hill Society, private circulation, 1960), p. 11.
[62] Maria Misra, 'Colonial officers and gentlemen', pp. 153-4 and *passim*. David C. Potter identifies generalism and gentlemanliness as part of the culture of the Indian Civil Service (and later the Indian Administrative Service). Potter, *India's Political Administrators*, p. 247.
[63] Annexure XVIII: 'Public Works and Railway (Engineering) Departments', *Islington Commission Report*, p. 329 (paragraph 11).

in both cases including Imperial and Provincial Services,[64] and occupied virtually every position in the Government of India's PWD Secretariat.[65] Ten years later, when the ISE had been formed, the RIEC's share of Chief Engineers (21 out of 34, or 62 per cent) and Superintending Engineers (57 out of 109, or 53 per cent) had dipped slightly, but was still considerable.[66] Consequently, the requirement for gentlemanliness outlived the College itself, as I will show shortly.

There was a second important requirement of the PWD engineer: that he be a competent generalist, able to tackle a wide range of problems. The maintenance of the physical infrastructure of government and the state, and of the canal and power systems sustaining agriculture, required a diverse set of skills. In 1870 the *Spectator* of London had described the qualities required of the engineer working in India thus:

> The ideal Engineer for India is a man who will take £1000 a year as his average income for life, and insist that all under him shall be content with their wages; who can build anything from a Tanjore tank as big as the lake of Lucerne to a cloacae for the last new stockade; who will regard an offer of a commission from sub-contractors as a deadly insult; who can keep accounts like a bank clerk . . .[67]

More than thirty-five years later the India Office continued, in selecting engineers for the PWD, to prize a strong grounding in a range of areas supplemented by practical experience. After the closure of the RIEC in 1906, engineering graduates appearing for interview at the India Office were advised to prepare the following subjects, considered the most important for service in the Department:

> Pure Mathematics (including the differential and integral calculus)
> Applied Mathematics
> Geometrical and Engineering Drawing

[64] Calculated from Government of India, Public Works Department, *Classified List and Distribution Return of Establishment, corrected up to 30th June 1912* (Calcutta: Superintendent Government Printing, India, 1912). APAC: IOR/V/13/216. Numbers for each rank include engineers holding temporary or officiating rank (e.g. a Superintending Engineer who is also an officiating Chief Engineer is counted under both heads.)

[65] *Ibid.* The positions were—Secretary to Government: W.B. Gordon; Deputy Secretary: G.H. le Maistre; Under Secretary: P. Hawkins; Inspector-General of Irrigation: M. Nethersole.

[66] Calculated from: Government of India, Public Works Department, *Classified List of Establishment, corrected up to 30th June 1922* (Calcutta: Superintendent Government Printing, India, 1922), APAC: IOR/V/13/220.

[67] Quoted in John Black, 'The military influence on engineering education in Britain and India, 1848–1906', *The Indian Economic and Social History Review*, 46, 2 (2009): 211–239, here p. 232.

Surveying and Geodesy
Strength of Materials and Theory of Structures
Hydraulics
Heat Engines
Materials used in Construction
Building Construction (wood and metal work; limes and cements; building with stone, brick, concrete)
Knowledge of the principles of road-making, waterworks, sanitary & railway engineering.

In addition to being familiar with this imposingly diverse list of subjects, applicants were also expected to have undergone practical training as apprentice to a civil engineer (one year if they were college graduates; three years otherwise).[68] Those selected were allotted to a province upon arrival in India, and would learn the particulars of the work they were placed on while on the job.

The 'gentleman generalist' paradigm of public works engineering is clearly illustrated in the typescript memoirs of a PWD engineer, G.F. Hall. After graduating from the Central Technical College in London c. 1909, Hall applied for a position in the Indian PWD and was interviewed at the India Office. Prior to the interview, he had 'spent weeks mugging up engineering formulae, details of cement and brick manufacture and the weights and composition of materials'. On the actual day, he was asked what his best sport had been at school in Marlborough (he played cricket, football and hockey, but was not exceptionally good at any of them); how he spent his leisure hours when at the Central Technical College (he said he worked all the time, but was pressed into admitting that he spent his leisure time on football, rowing and dancing); how he found Chatham, where he was undergoing a short training course as a member of the Special Reserve of the Royal Engineers (he liked it very much). '[A]nd so much for all my weeks of cramming!'[69] Hall's social and sporting accomplishments and his institutional pedigree clearly carried as much weight with the committee as his technical qualifications.

Hall was placed on a waiting list following his interview, but received an appointment the following year as Assistant Engineer (Imperial Service of Engineers) in the PWD, where he soon had to prove himself as a generalist.[70] Shortly after his arrival in India in 1911, he was

[68] See 'Indian Public Works Department: Note for the Information and Guidance of Candidates' in the *India Office List* for 1910, pp. 222-3; 'Indian Service of Engineers: Note for the Information and Guidance of Candidates' in the *India Office List* for 1928, pp. 278-9.
[69] G.F. Hall, 'All in the Day's Work' (typescript, 2 vols., 1947), APAC: MSS Eur D569/1 and D569/2, here Vol. 1, p. 43 (on the interview), p. 41 (on the Chatham course), and p. 40 (for Hall's engineering qualifications).
[70] The Record of Services in the *India Office List* for 1940 gives the following details: Hall, Geoffrey Fowler, CIE, MC, Indian Service of Engineers, Superintending Engineer, Bihar. Born 9th March 1888.

placed in charge of a sub-division on the Tribini canal in northern Bihar. He continued in irrigation work, interrupted by war service in Greece and France from 1916-18. Some years after he returned to India, he was transferred to the Roads and Buildings branch of the Bihar and Orissa PWD. Although he had little experience of building work and had failed an exam on building subjects early in his career, Hall was now given several assignments including the construction of schools, hostels and barracks and, in 1928, a host of arches and pylons as road decorations during the visit of the Viceroy and the Simon Commission to Patna.[71]

At every rank an engineer's duties were many and varied. As an Assistant Engineer he had to negotiate contracts, establish rates, assess finished work, and draw up bills. An official report claimed that in some sub-divisions, where the work was mainly related to maintenance, 'the duties of an assistant engineer make little demand on engineering skill'.[72] As Executive Engineer the officer might find himself 'undertaker to the Christian community.'[73] A Superintending Engineer was as much an administrator as a technical officer. His duties included supervising budgetary and accounts issues of his department, seeking and dispensing advice on technical matters, managing subordinate personnel, and corresponding with the provincial government (see list below). As Chief Engineer he was responsible for preparing annual reports on the activities of his department.[74] An engineer could also be deputed for a period of time on 'foreign service' to another province or department; for instance, some ISE officers of the United Provinces PWD were deputed to the Department of Education and thence as professors to Roorkee in 1934-5.[75] The diversity of a PWD engineer's duties is vividly illustrated by the following list of the files on G.F. Hall's desk on a single day in 1933, when he was a Superintending Engineer:

> Demarcation of Provincial roads.
> Furniture in Circuit Houses.
> Failure of District Board causeways.
> Chief Engineer's Inspection Note.

Joined the service 1 Oct 1911. Assistant Engineer: Nov 1911; Executive Engineer: Oct 1920; Officiating Superintending Engineer, May 1931 and again Feb 1933; confirmed, March 1933; Chief Engineer (temporary), Jan 1936.

[71] Hall, 'All in the Day's Work', Vol. 1, *passim*. The Simon Commission, controversial because it had no Indian members, was set up to assess the effects of the Montagu-Chelmsford reforms of 1919. John F. Riddick, *The History of British India: A Chronology* (Westport, CT: Praeger, 2006), pp. 106-7.

[72] Annexure XVIII, *Islington Commission Report*, p. 327.

[73] Hall, 'All in the Day's Work', Vol. 1, p. 133.

[74] E.g. *Administration and Progress Report of the Chief Engineer, United Provinces Public Works Department, Buildings and Roads Branch, For the year 1934-35* (Allahabad: Superintendent, Printing and Stationery, United Provinces, 1936), addressed by Chief Engineer Chhuttan Lal, to the Secretary to Government (United Provinces PWD, Roads & Buildings). APAC: IOR/V/24/3304.

[75] *Ibid*., Chapter 1, p. 2.

Ventilation in Police Barracks.
Encroachments.
Progress of experiments. Chief Engineer's comments.
Accountant-General's objection items in Divisional accounts.
Retired clerk wants reemployment.
Allotment of Deputy Magistrates' Quarters.
Estimator wants extension of leave.
Transfer of Police buildings from District Board to P.W.D.
Quadrennial repair estimates and allotments.
Additions and alterations to new Police Lines at Chaibassa.
Recovery of rent from the Headmaster of a school.
Disposal of an old mortuary.
Major works must have a budget provision.
Dismantlement of a Police latrine.
Site plan required for completion of Site Committee's proceedings.
A long list of road metal rates for approval.
Dismantlement of P.W.D. Inspection Bungalows no longer required.
Executive Engineer cancels casual leave.
Repair of machinery.
Special repair of machinery.
Metal collection and consolidation estimate of a road for sanction.
Charges for sanitary services in Circuit Houses.
Recoveries for materials issued to a contractor.
Revision of Municipal taxes.
An Executive Engineer wants permission to avail himself of the Pujah holidays.
Reminder to Government for certain land plans.
Petition for reinstatement from dismissed work-charged establishment.
Contract for repair of typewriters.
Big bridge design. Steel or submersible in reinforced concrete?
Grants required by District Boards.
District Board seeks advice re causeways.
Revision of standard measurements.
Advisability of deepening wells sunk through rock.
Inspection note on District Engineer's office.
Inspection note on an S.D.O.'s office.
Subsidence of roads in the mining area.
Candidates for P.W.D. Professional Examination.
Postings due to leave.
Leave without pay for not following medical advice.
Minor Works Return.
Transfer of Overseers.
Stocking lakes for fishing leases.
Appeals from contractors.
Application for post of 2nd. clerk.
A new building material from waste materials.
Short issue and recovery of materials.
Travelling allowance bills.
Many petitions.
Revision of building rates.
Idol and encroachment in Tasildhar's [sic] compound.
Allotment of funds from S.E.'s reserve.[76]

[76] Appendix I: 'Files on my table when I went to office on September 7th. 1933.', Hall, 'All in the Day's Work', Vol. 2, p. 550.

An engineer was supposed to learn on the job, by doing, and by seeking help where necessary. In 1930 Hall was asked to prepare a design for a bridge over the river Son at Dehri in Bihar. Dehri had a railway bridge belonging to the East India Railway (EIR), but no road bridge. Hall consulted irrigation engineers, the EIR's bridge engineer, and specialists working for European engineering firms in Calcutta before he drew up the plans. Recounting this incident in his memoir, Hall reflected that PWD engineers had to be resourceful, for they '[were] not specialists in any branch of engineering.'[77] Another skill a PWD engineer needed to develop was the ability to work in partnership with commercial contractors and suppliers of equipment and material. The link between British commercial interests and public works in India was strong: it might be said that the British engineering firms of Bombay and Calcutta existed primarily to procure equipment and undertake contracts for the building of public works and the railways.[78] Soon after he had handed in his designs for the Dehri bridge, Hall was summoned to Ranchi to help construct a jail for 2,500 prisoners as demonstrators courted arrest *en masse* as part of the Civil Disobedience movement. Having drawn up a rough design with his colleague Ian MacRae, Hall engaged an engineer from a private firm, the Kumardhubi Engineering Works, to prepare detailed designs for a number of sheds. (In view of the urgency of the situation, Hall had free rein. In any case a Superintending Engineer could exercise his discretion in selecting a contractor.) Together they worked out the estimated costs before Hall travelled to Calcutta to formalise the contract with the Kumardhubi Works' managing agents, Bird & Co. He spent several days in Calcutta to order materials from the engineering firms there. The firms, scenting a big customer in the midst of the Depression, plied him with cocktails and free transport, while he concluded deals at the upmarket restaurant, Firpo's, and on the golf course at Barrackpore. Throughout his narration of this episode in his memoir, Hall presents himself as a heroic upholder of law and order, and especially as a tough negotiator and manager of men and materials, rather than as the creator of a technically challenging design.[79]

The status of the Indian engineer

When senior European engineers and British policymakers pictured the ideal public works engineer, they thought not only of a generalist, a man of character and resource, but of a

[77] Hall, 'All in the Day's Work', Vol. 1, p. 248.
[78] Many engineering firms with European owners operated at this time, especially in Bengal. An example is the Gariahat Engineering Works, Ballygunge, proprietors TE Thomas and Co Ltd, Calcutta. In 1930 they were able to provide sheet iron workers, oxy-acetylene welders, mechanical engineers; manufacture wrought iron railings and gates for government use; act as contractors to government, the PWD, railways and municipalities. See entry in Commercial Industries section, *Thacker's Indian Directory* for 1930.
[79] Hall, 'All in the Day's Work', Vol. 1, pp. 251-5.

quintessentially *British* engineer. Indian engineers had to be made in their image, but could never quite hope to achieve the ideal of the gentleman generalist.

British attitudes to Indian engineers became particularly important in the interwar context of political reforms and Indianisation. There were exceptional success stories like those of Jwala Prasad, Chief Engineer Irrigation, United Province in 1932, and Madan Gopal Sardana, Superintending Engineer in the same department, and Principal of Roorkee, 1940-5; [80] but most Indians started modestly in the provincial services and dreamt of entering the ISE.[81] These engineers had constantly to be on their guard lest their competence or reliability should be questioned. As the son of one such engineer recalled:

> Father, who never relaxed from work, explained it to us by saying that Englishmen could afford to relax because if things went wrong they managed to explain it to each other, and took the attitude that things sometimes go wrong. But when an Indian made a mistake the reaction, *if an understanding one*, was that the job was perhaps too difficult for him; 'after all they did not have the skill or the experience; one must be careful with giving responsibility too soon …' [82]

British engineers' views of Indians ranged from paternalism to outright scepticism. G.F. Hall was never entirely at ease with his Indian colleagues and superiors, as revealed by his remarks about some of them in his memoirs. One Superintending Engineer, he claimed, would listen to the grievances only of his fellow caste men when on inspection tours.[83] Another colleague, who was due to accompany Hall on an official tour of the Punjab's irrigation facilities, gave him the jitters for social reasons. The Indian's food habits were different from Hall's, who 'foresaw that we were unlikely to be entertained together, and that as I could not very well leave him to his own devices I should have to spend my time in dak bungalows and see nothing of the social life of the two Provinces.'[84] When Hall was an Executive Engineer in the 1920s, he had an Indian Superintending Engineer, Rai Bahadur S.C. Chakarbatty, whom he thought 'a nice elderly Bengali but unwilling to accept responsibility or issue definite orders. He was consequently little more than a post office between myself and the Chief Engineer.'[85]

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[80] Appendix to Mital, *History of the Thomason College*, pp. 262-3 and p. 265.
[81] E.g. Ram Das of the Punjab PWD (Irrigation), who rose from sub-divisional officer to the ISE. His career is described in his son's memoir: Prakash Tandon, *Punjabi Century: 1857-1947* (London: Chatto and Windus; Toronto: Clarke, Irwin and Co, 1961).
[82] Prakash Tandon, quoted in Daniel Klingensmith, *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007), p. 232. Emphasis mine.
[83] Hall, 'All in the Day's Work', Vol. 1, p. 71.
[84] *Ibid*., p. 159.
[85] *Ibid.*, p. 182.

Further on the theme of accountability, Hall recounted the case of an Indian engineer in 1934 who was transferred out of his Circle following the devastating Bihar earthquake of that year and replaced by a Briton. The engineer was not offended, but 'thanked [his superior officer] profusely for his kindness in relieving him of such responsibility!'[86] Hall's lukewarm attitude to his Indian colleagues was not due to any technical incompetence on their part. Instead, he thought they came up short on non-technical parameters of competence: integrity, courage and responsibility.

As we saw in the previous section, colonial officials and British legislators were also unconvinced of the suitability of Indian engineers for senior and responsible positions in the PWD, but found themselves walking a tightrope. On the one hand, even for those statesmen who would rather that the British did not loosen their control on governance, the interwar constitutional reforms were a *fait accompli* and a necessary evil, given official sanction by Secretaries of State and Viceroys beginning with the pair of Montagu and Chelmsford in 1919. On the other hand, most policymakers were keen to ensure continuity in the government's bureaucracies and anxious not to diminish the attractiveness of these to existing and future British officers. In balancing the two considerations, they confronted and gave expression to their attitudes to Indian engineers, their technical competence, their administrative ability, and their general character.

In a Minute appended to the report of the Lee Commission in 1924, one of its members, Sir Reginald Craddock, a former Lieutenant-Governor of Burma, expressed his regret at the (inevitable) changes to the PWD's engineering services caused by the provincialisation of its Roads and Buildings branch. Thereafter, recruits to the branch would almost certainly be Indians, of whom there were now enough with the required technical knowledge. '[W]ith such excellent engineering colleges as exist in India there will be no lack of qualified Indian candidates to construct and maintain such works as still remain in provincial charge'. But technical competence was not enough. Craddock hoped that the British engineers currently in the Service would 'serve out their full time and impart their high standards of skill, duty and integrity to those who come after them.' He felt that 'it will be many years yet before [the Roads and Buildings branch of the ISE], with its high traditions, will disappear'. The 'high traditions', it would seem, were related to British character.[87]

The views of politicians of various hues found systematic expression in a 1935 Parliamentary debate on the Government of India Bill. In relation to the proposed

[86] Hall, 'All in the Day's Work', Vol. 2, p. 341.
[87] 'Minute by Sir Reginald Craddock upon certain of the conclusions of the Commission', *Lee Commission Report*, pp. 127-138, here p. 133.

provincialisation of the PWD's Irrigation branch, Patrick Donner, Conservative MP for Islington West, moved an Amendment seeking the continuation of recruitment by the Secretary of State as the primary means of staffing the Irrigation service, and was supported by several other Members of Parliament.[88]

Donner felt that the proposed provincialisation of Irrigation 'will mean in practice the disappearance of the British element.' He argued that the 'lesson' from departments transferred earlier had been one 'of deterioration of efficiency and of administration.' Irrigation was essential to the welfare of India. If the Government ignored the importance of irrigation, they were 'risking … the very existence of millions of the population, and put no greater value on these lives than they would on a 5-franc counter in the Casino at Monte Carlo.' Donner then linked the efficiency of irrigation work directly to the presence of British engineers. Irrigation in India was 'a purely British creation *brought about by British integrity, resource and impartiality*, which has no counterpart in present times or during the centuries in the past.'[89]

The Duchess of Atholl (Conservative MP for Kinross and West Perthshire)[90] cited evidence given to the Simon Commission[91] on British and Indian irrigation engineers. Sir Charles Harrison, Chief Engineer of the large-scale Sukkur Barrage project in Sind (completed in 1932)[92] had 'stressed the tremendous importance of the impartial distribution of water'. He had told the Commission 'that Indian engineers, *though often technically efficient*, were subject to outside influences pressing on them to make a partial distribution of water, influences which often made it difficult for them to carry out their duties as efficiently and impartially as they would wish to do.' Harrison's 'own Indian officers had said to him that they themselves recognised that British officers were in a far stronger position than they were, because they were

[88] 'Clause 233.—(Services recruited by Secretary of State.),' House of Commons Debate, 4 April 1935, Vol. 300, cc. 582-635 (Hansard). Hereinafter cited as Hansard HC Debate 4.4.1935.The Amendment sought to retain recruitment by the Secretary of State for the Forestry Department as well as the Irrigation Department, but the debate was mostly about Irrigation. For his party/constituency details, see entry on Sir Patrick Donner in 'Members', House of Commons Parliamentary Papers, http://parlipapers.chadwyck.co.uk/fullrec/members.do?member=03756 (accessed 12 June 2012).

[89] Hansard HC Debate 4.4.1935, cc. 584-8. Emphasis mine.

[90] 'Stewart-Murray, Katharine Marjory, duchess of Atholl', *Concise Dictionary of National Biography*, Oxford University Press, March 1992 (via http://www.knowuk.co.uk, accessed 29 January 2011).

[91] The Statutory Commission or Simon Commission (1927-30) assessed the effects of the Montagu-Chelmsford reforms of 1919. John F. Riddick, *The History of British India: A Chronology* (Westport, CT: Praeger, 2006), pp. 106-7.

[92] 'India's Great Barrage', *The Observer*, 17 January 1932, p. 11. Speaking on the opening of the barrage, the Governor of Sind, Lord Lloyd, said that although the current atmosphere was critical of British rule, and despite the fact that the project had had British engineers in senior and Indians in junior ranks, engineers of the two races had 'been co-operating quite willingly together.'

not exposed to the pressure of members of their community or their family to give them more than their fair share of water.'[93]

The question of impartiality was felt to be of paramount importance in the heavily agrarian provinces of Sind and (especially) Punjab. Here one of the primary responsibilities of the irrigation engineer was the efficient distribution of canal water. 'In a dry country with scanty rainfall' like West Punjab, receiving canal water was a matter of survival for the farmers—and if they did not get it, they 'could … be very violent'.[94] The threat of violence and unrest in these provinces was very much in the minds of the parliamentarians. Patrick Donner warned that if the land were to become unproductive, the people '[would] turn upon us in their rage and fury, because they will say that we are responsible for their poverty.'[95]

Communal pressures were one thing, but the supporters of the Amendment drew attention to an even bigger evil: corruption. Donner averred that 'bribery [was] going to enter into this question of water.'[96] The Duchess of Atholl referred to a Chief Engineer (Irrigation), United Provinces, who had told the Simon Commission that landowners and farmers bribed Indian subordinate officers (for larger shares of water), and that British engineers 'were more insistent on checking it' than Indian engineers.[97] Another MP, Vice-Admiral Taylor, expressed this view most emphatically. 'The whole basis of the irrigation service,' he said, was 'the efficiency, integrity, good administration, and freedom from the corruption and bribery which, unfortunately, undoubtedly exist in India as in other places. . . if we eliminate the English official from the irrigation service, there is no question that the administration of that service will go down.'[98]

Donner's supporters included Winston Churchill (Conservative MP for Epping),[99] who felt that 'this is one of the most frightful responsibilities that the House of Commons has ever been asked to take.' He painted a dire picture of Irrigation under Indian engineers after

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[93] Hansard HC Debate 4.4.1935, c. 594. Emphasis mine. That Indians felt pressurised by their own communities is corroborated by at least one independent source. Irrigation engineer Ram Das of Punjab, in his son's words, faced the 'difficulty of fitting a new definition of integrity into the traditional pattern of duties towards the family and caste. Father used to envy his English colleagues who, being far away from home, had no relations demanding favours.' Tandon, *Punjabi Century*, p. 34.
[94] Tandon, *Punjabi Century*, p. 50.
[95] Hansard HC Debate 4.4.1935, c. 589.
[96] *Ibid.*, c. 588.
[97] *Ibid.*, c. 594.
[98] *Ibid.*, cc. 615-6.
[99] Paul Addison, 'Churchill, Sir Winston Leonard Spencer (1874–1965)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edition, Jan 2011 (http://www.oxforddnb.com/view/article/32413, accessed 8 June 2012). Churchill was part of a 'vindicative [sic] majority' in the Parliament with whom 'a small band of members sympathetic to the Indian cause' engaged during the debates on the 1935 Government of India Bill as a whole. Burton Stein, *A History of India*, 2nd edn, edited by David Arnold (Oxford: Wiley-Blackwell, 2010), p. 326.

provincialisation. Referring to the growing population of Punjab and Sind under artificial irrigation, he told the Secretary of State Sir Samuel Hoare that if recruitment was handed over to the provinces, he would be responsible for 'undermining the means by which these new-come millions get their new-found food.' He added that this was 'only part of the general wreckage. It is only part of this vast process of liquidation of what Britain has done in India.'[100]

A few MPs disagreed. Edward Turnour, the Earl Winterton (Horsham; Conservative)[101] took exception to Churchill's remarks, which '[suggested] that [Indians] are so corrupt, so incompetent, so inefficient that if they are entrusted with this great charge they will undermine the whole fabric of India.' Winterton asked: 'Has ever a more serious charge been made against any people?'[102] Sir Murdoch Macdonald (Inverness; Liberal), a former irrigation engineer in Egypt and a recent President of the Institution of Civil Engineers,[103] felt that 'it would be very wrong to take out of the hands of the people of India the control of the irrigation service.' He did not think the issue of corruption was a real problem where there existed sufficient water. Corruption, if it did come into play, could only exist at the lowest subordinate levels, 'the people who turn the smallest valve'; from his experience in Egypt that type of corruption could not be stopped even by the presence of senior British engineers in the department.[104]

Macdonald and Winterton's views notwithstanding, a great number of MPs had expressed a lack of faith in Indian engineers. As a concession to their views, the Secretary of State (Sir Samuel Hoare), representing the government, offered to 'consider the proposal that the Secretary of State should make recruitment of officers'. In the end Donner withdrew his Amendment on the basis of this 'assurance'.[105] Ultimately, the original compromise in the Government of India Bill was retained in the Act of 1935—recruitment for the Irrigation service would be carried out in India, with the Secretary of State retaining the option to appoint officers to any service or office concerned with irrigation in India if it was deemed necessary 'for … securing efficiency in irrigation in any Province'.[106]

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[100] Hansard HC Debate 4.4.1935, cc. 619-20.
[101] 'Turnour, Edward, sixth Earl Winterton and Baron Turnour', *Concise Dictionary of National Biography*, Oxford University Press, March 1992 (via http://www.knowuk.co.uk, accessed 12 June 2012).
[102] Hansard HC Debate 4.4.1935, c. 621.
[103] H. E. Hurst, 'MacDonald, Sir Murdoch (1866–1957)', *rev*. Elizabeth Baigent, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 (http://www.oxforddnb.com/view/article/34709, accessed 8 June 2012).
[104] Hansard HC Debate 4.4.1935, cc. 617-8.
[105] *Ibid*., c. 619 and c. 623.
[106] *Government of India Act, 1935* (26 Geo. 5, Ch. 2), paragraph 245 (p. 149).

Conclusions

This chapter has offered the first full description of the changing personnel, recruitment, organisation and administration of PWD engineers over the period 1900-40. It reveals two important features of the engineering services. The first is that despite the Government of India's drive to Indianise its services, distinctions were always made between European and Indian engineers. The separate Imperial Service and Provincial Service lasted until 1920; thereafter, within the Indian Service of Engineers, distinctions in salary and privileges continued to be made between engineers of Indian and British domicile. The second important feature, which helps to account for this differential treatment, is that many British officials and MPs viewed the European engineer as a bulwark against the threat of lowered standards in the PWD—which they thought would inevitably accompany Indianisation. For this reason, successive Royal Commissions rejected wholesale Indianisation of the ISE, and British MPs resisted (though unsuccessfully) the proposed provincialisation of the Irrigation branch of the ISE. Such views held sway in spite of the difficulty of attracting British recruits to India after World War I, and the acknowledged quality of the Indian engineering colleges from which the Indian members of the ISE were drawn.

Change did occur, albeit slowly: by the late 1930s, both branches of the PWD had been placed under elected provincial ministers, the ISE was more than fifty per cent Indian, and recruitment in Europe had all but ceased (although the Secretary of State retained special powers to appoint irrigation officers). The point is that this change was carefully managed by the government, not only by maintaining a European core in the ISE, but by ensuring that the Secretary of State had control over it, and more generally over the PWD. I have argued that the reasons for this are best understood by studying the normative culture of public works engineering, as embodied in the training, recruitment and career paths of its practitioners. The ideal of the public works engineer was cast in a British mould. He was to be a gentleman and a generalist, possessed of integrity, courage and resourcefulness. British engineers and policymakers were unconvinced of the extent to which these qualities might be found in the Indian engineer. They held that while Indian PWD engineers might be technically competent, their personal qualities were likely to fall short of the ideal of the gentleman generalist, leaving them open to corruption, partiality and incompetence as administrative officers.

It is important to understand the significance of these contemporary ideas on race and technical expertise. They not only influenced the experiences and relationships of PWD engineers, and the ways in which the PWD was reorganised and Indianised; they also reflected,

in microcosm, larger anxieties about the future of British rule in India and about Indians' ability to govern themselves.

CHAPTER 5

Efficiency, Loyalty, and the Limits of Indianisation

Technical officers in the railways

Introduction

Engineers and other officers with technical duties were vital to the running of India's railways in the twentieth century. By the late 1930s, more than 40,000 miles of track were being operated in the subcontinent by nearly two thousand officers, around half of whom were Indians and the rest Europeans.[1] This chapter deals with these little-studied cadres in the period 1905-40. In particular, it extends the analysis made in the last chapter about the colonial government's response to Indian politicians' demands for Indianisation. I show that while, as in the PWD, the necessity of retaining a European kernel of higher engineering and allied posts was stressed, this was done in the railways more on grounds of security than of gentlemanliness or integrity.

The voluminous academic literature on the railways rarely touches on this issue, although it addresses themes such as the impact of the railways on colonial India's economy, the reception of the railways and their representation in Indian literature, the mobilisation of labour in the building of the railways and for their workshops, and the railways' creation of racial and caste-based hierarchies.[2] Like the majority of these studies, the few works that address the history of technical experts in the railways focus mostly on the long nineteenth century.[3] Work on the railways in the twentieth century tends, like other accounts of science, technology and medicine in India, to follow the arc of the grand narrative of Indian history—entrenched colonialism until World War I; increasingly powerful nationalists and a receding

[1] Sources for these numbers appear later in this chapter.

[2] See for instance I.D. Derbyshire, 'Economic Change and the Railways in North India, 1860-1914', John Hurd, 'Railways', and Daniel Thorner, 'The Pattern of Railway Development in India', collected in Ian J. Kerr (ed.), *Railways in Modern India* (New Delhi: Oxford University Press, 2001); Harriet Bury, 'Novel Spaces, Transitional Moments: Negotiating Text and Territory in Nineteenth-Century Hindi Travel Accounts', Marian Aguiar, 'Railway Space in Partition Literature', and Ian J. Kerr, 'The Railway Workshops and Their Labour: Entering the Black Hole' in Ian J. Kerr (ed.), *27 Down: New Departures in Indian Railway Studies* (New Delhi: Orient Longman, 2007); Manu Goswami, *Producing India: From Colonial Economy to National Space* (Chicago and London: University of Chicago Press, 2004), Chapter 3.

[3] Ian J. Kerr, *Building the Railways of the Raj: 1850-1900* (Delhi: Oxford University Press, 1995); Ian Derbyshire, 'The Building of India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995), pp. 177-215.

colonial state thereafter. Consequently, they portray the development of the railways in the interwar years as 'dominated by the movements for national freedom and the consequences of [the World Wars]'. Ian Kerr's account of the period 1905-47 is titled '"Nationalizing" the Railroads', and stresses the growing demands by nationalists to 'make [the railways] more Indian and more responsive to Indian problems, wants and aspirations'.[4] He notes that nationalists demanded more appointments for 'native' Indians (Indianisation), and the taking over by the state of railway lines run by London-based companies (nationalisation). Daniel Headrick draws a direct link between these two demands, writing that 'Indianization began right after [World War I] as the government acquired the various railway companies and influenced their personnel policies.'[5] Yet, as this chapter will show, these valuable studies neglect the specificities of the Indianisation story, which followed a different pattern for different departments of the railways, and for Superior as opposed to Subordinate staff.

In addressing these specifics, this chapter aims to enhance understandings of the politics of railway Indianisation and the processes by which the state implemented it. While accepting the importance of nationalist politics, it argues also for the significance of incremental changes within the government machinery.

Drawing on government employment lists and commercial directories, the contemporary Railways press, engineers' memoirs, official reports and exchanges in the British and Indian Legislatures, the chapter begins by describing the organisational structure and systems of management of Indian railways in the period 1905-20. It then charts interwar debates on nationalisation and Indianisation showing how they were informed by contemporary views on the importance of engineers on the railways and the abilities of Indians—views which revolved around a conception of the railways as central to the security of the colonial state. Finally, the chapter examines employment statistics to assess the extent to which Indianisation took place.

The Railway Bureaucracy, 1905-1920

Between 1905 and 1940, India's railway network was among the five largest in the world, along with the United States, Russia, Germany and Canada.[6] This network was a heterogeneous

[4] Ian J. Kerr, *Engines of Change: The Railroads That Made India* (Westport, CT and London: Praeger, 2007), Chapter 6. The quotes are from pp. 112-3.
[5] Daniel R. Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York and Oxford: Oxford University Press, 1988), p. 341.
[6] Comparison between countries in Table 3.1 on p. 55 of Headrick, *Tentacles of Progress*. The table gives the total length of India's railways in 1940 as 72,144 kilometres, which works out to close to 45,000 miles.

assortment of railway systems of varying gauges, owned and run by different entities. Of these the most important categories were as follows:

1. Railways owned and managed by the Government of India (referred to simply as 'state railways')
2. Railways owned by the Government of India and managed by a company
3. Railways owned and managed by a company
4. Railways in the princely states (which might be run by the ruler's government or by a company).

The extent of each type of railway in this period can be gauged from the official statistics for 1920-21. In that year the Government of India operated 8,929 miles of railroad, the Companies 25,211 miles, and the princely states 2,889 miles.[7] Table 5.1 lists the main railways under different categories of ownership and management.

[7] Railway Board (India), *Railways in India: Administration Report for the year 1920-21,* Vol. I (Simla: Government Central Press, 1922), p. 6.

***Table 5.1**: Ownership and management categories of railways in India, 1920-1*

Category	*Name of railway*
Owned and run by the state	North-Western Railway, East Bengal Railway, Oudh & Rohilkund Railway, Jorhat (Provincial) Railway, Aden Railway
State-owned but company-managed	Bombay Baroda & Central India Railway; Great Indian Peninsula Railway; Madras & Southern Mahratta Railway; Bengal-Nagpur Railway; East India Railway; South India Railway; Burma Railways; Assam-Bengal Railway; Rohilkund and Kumaon Railway; Bengal & North-Western Railway (the last two partially company-owned)
Private-owned and company-managed (with domicile of the company in brackets)	[Hyderabad] Nizam's Guaranteed State Railway (England); Martin & Co (India); McLeod & Co (Ind); Bengal Dooars Railway (England); Darjeeling-Himalayan Railway (Ind); Barsi Light Railway (Eng); Assam Railways and Trading Co (Eng); Guzerat Light Railways (Ind); Bengal Provincial Railway (Ind); East India Distilleries and Sugar Factories Ltd (Ind); Dehri-Rohtas Light Railway (Ind); Tezpore-Balipara Light Railway (Ind); Madaya Light Railway (Ind); Jagadhri Light Ry (Ind).
Run by the princely states	Railways of Jodhpur, Bikaner, Mysore, Gwalior, Gondal, Bhavnagar, Junagad, Morvi, Udaipur, Navanagar, Dholpur, Cutch

***Source**:* Railway Board (India), *Railways in India: Administration Report for the year 1920-21*, Vol. I (Simla: Government Central Press, 1922).

Of the four types of railways, this chapter is especially concerned with (i) state railways and (ii) state-owned but company-run railways. These categories accounted for the longest and economically the most important lines.

Until 1905, the state lines constituted a Railways branch under the Public Works Department (PWD). In that year the government dissolved the PWD's Railways branch, and constituted instead a central Railway Board with regulatory powers over all railways in the country (irrespective of ownership/management category).[8] Managers of the state railways and the Directors of the company railways would report to the Railway Board. The most senior of the Board's three members was its President. He had equivalent standing to a Government

[8] Kerr, *Engines of Change*, p. 25 and pp. 75-9; G. Huddleston, *History of the East Indian Railway* (Calcutta: Thacker, Spink and Co, 1906), Chapter 1.

Secretary and reported to the relevant Member (usually the Member for Commerce and Industries) of the Governor-General's Executive Council.[9]

The creation of the Railway Board was the result of a report by Thomas Robertson, who was commissioned by the Secretary of State in 1901 to study the administration of railways in India.[10] This was in response to complaints from the companies that the state—through Government Consulting Engineers, Government Examiners of Accounts, and government-appointed directors on the companies' boards—had undue control over 'the management and revenue expenditure' of the company-run railways, whereas they gave the state railways considerable freedom. Robertson stressed the need for uniformity in the running of the railways, whether state- or company-run, and the Railway Board was his scheme for ensuring this.[11]

The result, for the period beginning 1905, was that both state and company railways had broadly similar structures. The 'gazetted' (Superior) officers and 'non-gazetted' (Subordinate) staff of the state-managed railways were mirrored by the company-run railways' 'covenanted' (contracted) and 'non-covenanted' employees.[12] Both had similar arrangements in matters of salary and leave.[13]

Railway departments: functions and composition

Most railways, whether run by the state or by a company, were divided into a number of departments as follows:

1. Agency
2. (Civil) Engineering
3. Traffic (or Transportation (Commercial))
4. Locomotive and Carriage & Wagon (or Transportation (Power), or Mechanical Engineering)

[9] East India (Railway Committee, 1920-21), *Report of the Committee appointed by the Secretary of State for India to enquire into the administration and working of Indian Railways* (Cmd. 1512, London: HMSO, 1921), Chapter IV. This report is hereinafter cited as *Acworth Committee Report*.

[10] *Statement Exhibiting the Moral and Material Progress and Condition of India During the Year 1903-04*, p. 130. The full title of Robertson's report is: *East India (Railways). Report on the Administration and Working of Indian Railways. By Thomas Robertson, C.V.O., Special Commissioner for Indian Railways* (Cd. 1713, London: HMSO, 1903). Hereinafter cited as Robertson, *Report.*

[11] Robertson, *Report*, Chapter 1. The quoted phrase is Robertson's, and appears on p. 13.

[12] See L.A. Natesan, *State Management & Control of Railways in India: A Study of Railway Finance Rates and Policy during 1920-37* (Calcutta: University of Calcutta, 1946), p. 365, footnote 4.

[13] See *ibid*., p. 368 and p. 386. Although the new system was meant to give companies freedom of operation, the Railway Board retained a degree of control over them. In 1912, for instance, it vetoed the East India Railway Company's proposal to increase its engineers' salaries, partly on the grounds that this might cause dissatisfaction among the employees of other company-managed railways who did not receive a similar raise. 'East India Railway (Pay of Engineers)', House of Commons Debate, 13 November 1912, Vol. 43, c. 1970 (Hansard). This and other House of Commons debates cited below were accessed via http://hansard.millbanksystems.com.

5. Stores
6. Other (including electrical, signal and bridge engineers).

Each of these departments (discussed in detail below) had a 'Superior Service' and a 'Subordinate Service'. This chapter is concerned with the Superior Services, which comprised the gazetted/covenanted officers (referred to henceforth as 'Superior officers' or simply 'officers'). The following description of recruitment and functions of officers in each department applies mainly to the state railways. Where the company railways differed considerably, attention is drawn to the difference. In general, however, commercial and government lists of employees indicate that the organisational structure of the company lines paralleled that of the state lines.[14]

The first department, the Agency, formed the highest rung of the railway bureaucracy. It comprised the chief managers of each railway (Agents and Deputy Agents on the company railways; General Managers and Assistant General Managers on the state lines). Agents of the company lines reported to the Board of Directors in London (which was further accountable to the Railway Board in India). The General Managers of the state railways reported directly to the Railway Board. Agents and Managers were officers who had risen through the ranks of the other departments, usually Engineering or Traffic.[15]

Civil Engineering, officially listed simply as 'Engineering', was the main executive department. Its officers carried out three main types of tasks: maintenance and repair of functioning railroads, known as 'open lines'; survey and construction work on new lines; and (especially for higher-ranked officers) inspection of lines.[16]

On the state railways, which had earlier been a branch of the PWD, the organisation of engineers broadly paralleled that department (as described in Chapter 4). Engineer officers were divided into Imperial and Provincial Services. Imperial Service engineers were recruited in two ways. A few were appointed from the Royal Engineer Corps. Others were selected by the Secretary of State from among candidates with an engineering degree from a British college plus a year's practical experience in civil engineering. Candidates with equivalent qualifications were also eligible, provided they had had three years' practical experience.[17] Provincial Service

[14] E.g. *India Office List* and *Thacker's Indian Directory*, various years.
[15] Annexure XIX: 'Railway Department (Revenue Establishments)', *Royal Commission on the Public Services in India*. *Report of the Commissioners,* Vol. I (Cd. 8382, London: HMSO, 1917), pp. 338-44, here p. 388. This document is hereinafter cited as *Islington Commission Report*.
[16] Annexure XVIII: 'Public Works and Railway Department (Engineering Establishment)', *Islington Commission Report*, pp. 326-37, here p. 326.
[17] *Ibid*., p. 330. Before 1905, when the railways were part of the Public Works Department (PWD), the bulk of these engineers had been recruited from the Royal Indian Engineering College at Cooper's Hill (see Chapter 4).

engineers were recruited from the Indian engineering colleges.[18] The term 'Provincial Service' did not imply any relation to the provinces, but denoted only that its members were recruited in India on terms different from those of the Imperial engineers. As in the case of the PWD, this was deemed an unnatural distinction as Provincial and Imperial engineers bore identical responsibilities, and after World War I the two branches were merged into a single Indian Railway Service of Engineers (IRSE), whose officers were recruited in both Britain and India.[19]

On company-run railways, civil engineers were mostly graduates of the British engineering colleges with a few years of practical experience, often on a British railway. For instance Thomas Guthrie Russell (1887-1963) took an engineering degree in Glasgow University, was apprenticed to a firm of civil engineers in Glasgow for three years, then worked for a further three years on the North British Railway before joining the Great Indian Peninsula Railway as Assistant Engineer in 1913.[20] Cyril Lloyd Jones (1881-1981) graduated from the Central Technical College in London in 1899, then worked for a variety of engineering firms (including Mertz and Maclellan, for whom he carried out survey work for a light railway between Maidstone and Chatham), before joining the Nizam's Guaranteed State Railway Co. in Hyderabad in 1904.[21] The company railways usually appointed engineers on renewable three-year contracts. Most engineers did extend their contracts, serving out their entire careers in India (though they might switch railways within the country).[22]

The Traffic Department, also referred to as Transportation (Commercial), was engaged in logistical planning and the control of trains. Officers of this department prepared time tables, dealt with freight, and supervised station masters, signallers, guards and foremen to ensure the smooth running of trains.[23] Before 1907 Traffic officers on the state lines were recruited entirely in India; from that year, recruitment for about sixty per cent of the vacancies was done in

[18] *Ibid.*, p. 326.
[19] See *Statement Exhibiting Moral and Material Progress*, 1930-1**,** pp. 258-60 for steps in railway service reorganisation, and Chapter 4 of this thesis for the analogous reorganisation of the public works engineering service. See Annexure XVIII, *Islington Commission Report*, for the rationale behind the amalgamation of the Imperial and Provincial Services.
[20] Obituary, 'Sir Thomas Guthrie Russell', ICE *Proceedings*, Vol. 31, Issue 1 (May 1965), pp. 126-7.
[21] Omar Khalidi (ed.), *Memoirs of Cyril Jones: People, Society and Railways in Hyderabad* (New Delhi: Manohar Publications, 1991), pp. 22-8.
[22] Ian Derbyshire, 'The Building of India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi and London: Sage, 1995), pp. 177-215, here p. 181.
[23] 'Indian State Railways: Regulations for Appointment to the Transportation Department', *India Office List* for 1928, p. 286; Appendix I: 'Courses of Training Prescribed for Probationers in the Transportation and Commercial Departments', *ibid.*, p. 287. See also 'Indian State Railways: Regulations for Appointment to the Traffic Department' (including Appendix I), *India Office List* for 1910, pp. 228-9.

Britain—a temporary practice begun because of the lack of qualified candidates in India.[24] These officers, who were generally not degree engineers, were selected in England by the Secretary of State from among applicants possessing a university degree, a technical diploma, or at least two years' experience in Traffic Department work on a British or colonial railway along with 'a sound general education'.[25] In addition some officers were appointed from the Royal Engineer Corps. It appears that applicants in India had to be graduates, though it is unclear whether they were required to possess practical experience like their English counterparts.[26]

Mechanical Engineering, or Transportation (Power), consisted of the Locomotive and Carriage & Works Departments. Its officers were not degree engineers either. Applicants were required to have knowledge of materials and applied mechanics, and to be able to calculate stresses on and conduct repairs on locomotives and other machinery. They were almost entirely recruited in Britain by the Secretary of State. Loco officers were selected from among men with three years' training in railway company workshops and six months' training in running sheds and firing, while Carriage and Wagon candidates were required to have been apprentices in the shops of a railway or builder of wagons, and have had a year's experience as 'outside assistant' on a British line.[27]

Officers of the Stores Department were in charge of procuring, managing and accounting for supplies. They were recruited entirely in India 'from among candidates "of good education and suitable social position"', but very few Indians were among those selected.[28] Other miscellaneous officers included medical and railway officers as well as technical specialists (bridge engineers, signal engineers, mining engineers, and colliery engineers). These specialists, on the evidence of the names in government employment lists, were almost all Europeans—probably because training in branches other than civil engineering was not yet being offered at the Indian engineering colleges.[29]

Railway bureaucracies: engineering-centric and largely 'European'

Several features of this bureaucratic set-up stand out. The first is that with the partial exception of the Traffic and Stores Departments, the Superior Service was a cadre predominantly of

[24] Annexure XIX, *Islington Commission Report*, p. 338.
[25] 'Indian State Railways: Regulations for Appointment to the Traffic Department', *India Office List* for 1910, p. 228.
[26] The Islington Commission's report (1917) recommended that candidates in India should be graduates of a university or of Roorkee Engineering College (or possess an equivalent qualification). Annexure XIX, *Islington Commission Report*, p. 339.
[27] 'State Railways: Regulations for Appointment to the Locomotive and Carriage and Wagon Departments', *India Office List* for 1928, pp. 289-90; Annexure XIX, *Islington Commission Report*, p. 339.
[28] Annexure XIX, *Islington Commission Report*, p. 340.
[29] *India Office List*, various years.

officers with technical qualifications or experience, engaged in technical work. Civil engineers traditionally occupied a pre-eminent position (as opposed to the non-engineer officers), their prominence dating back to the pioneer days of the nineteenth century, when the construction of new lines was the most important task.[30] This continued into the early twentieth century: throughout our period the Superior officers of the (Civil) Engineering Department were more numerous than those of any other department.[31] In official reports and employment lists, it was usually the Engineering Department that was listed immediately after the Agency, indicating its importance in the organisational hierarchy.

Civil engineers were present on the companies' Boards of Directors, on the Railway Board, and as managers/ Agents of the state- and company-run railways. For instance, Sir Robert Highet (1859-1934), trained by pupillage in Ayr, joined the East India Railway as Assistant Engineer in 1883, rose to Chief Engineer in 1903 and subsequently Agent in 1912. After returning to England in 1920, he became Chairman of the East India Railway Company and a director of the Nizam's Guaranteed State Railway Company.[32] Indeed senior officers from the Engineering Department were sometimes placed in charge of other departments like Stores, as in the case of Sir Thomas Guthrie Russell on the Great Indian Peninsula Railway (GIPR) in 1923.[33]

The second significant feature of the railways' Superior Services was the strong military influence on their culture, a feature they shared with public works engineering.[34] However, while in the PWD this was the continuation of a tradition—military engineers had built the earliest public works—on the railways, military engineers also performed a strategic function. Historians have noted the strategic importance of railways in frontier regions, and the long-established policy of designing railway stations as fortresses to be protected from potential insurgents.[35] Railway employee lists show that the military presence on the railways (particularly the state railways) in the form of Royal Engineer officers was considerable, especially in the early part of the twentieth century.[36] In 1913, for example, 48 of the 277 state

[30] See Ian J. Kerr, *Building the Railways of the Raj: 1850-1900* (Delhi: Oxford University Press, 1995) for the role of civil/construction engineers in the railways in the nineteenth century.
[31] As per statistics presented later in this chapter.
[32] Obituary for Sir Robert Swan Highet, CBE, 1859-1934, in *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol. 240, Issue 1935 (1935), p. 787.
[33] He joined the GIPR as Assistant Engineer in 1913, and was made Controller of Stores in 1923. Guthrie Russell went on to become Chief Commissioner, Railway Board from 1929-40. Obituary, 'Sir Thomas Guthrie Russell', ICE *Proceedings*, Vol. 31, Issue 1 (May 1965), pp. 126-7.
[34] See Chapter 4 above.
[35] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton: Princeton University Press, 1999), pp. 165-6; Goswami, *Producing India*, pp. 116-7.
[36] Kerr, *Engines of Change* notes the connection between the racial composition of railway staff and security concerns, though he does not mention the Royal Engineers specifically. See p. 118.

railway officers appearing in the *India Office List* were Royal Engineers.[37] R.E.s were present in the Engineering as well as Traffic Departments, usually having been appointed to the Railways soon after receiving their first commission. Such officers spent their entire careers in the railways, although they retained their military rank and were sometimes called away to military service. An example is the career of Captain Cecil Ford Anderson, R.E. (b. 1872), as detailed in a 1910 government dossier. Anderson received his first commission as Second-Lieutenant in 1892 and worked on various state railways from 1895 onwards, occasionally being deputed on military service—as in May-December 1896, when he joined the Soudan Expeditionary Force.[38]

In addition to this, most civil engineers on the railways volunteered for army training. Each railway had its own auxiliary force made up of volunteers to guard its line in the event of conflict. A photograph of (British) officers featuring in a Railway magazine, captioned 'E.B. [Eastern Bengal] Railway Battalion Auxiliary Force in Camp at Paksey – 24th January, 1930', is typical.[39] In their memoirs, anecdotes abound of the close links between railway engineers and military life. Cyril Lloyd Jones, a prominent railway engineer in Hyderabad, got on well with a local army regiment, the 61st Pioneers, even getting them to help occasionally with construction/repair work on the Nizam's Railway lines.[40] Victor Bayley, who joined the railways as an Assistant Engineer in the 1900s, was a member of the Simla Volunteers when working in the Railway Board's office in 1913. When war broke out soon after, he was made a Second-Lieutenant, and then a Temporary Captain on a railway line based in Baghdad. In the 1920s, when he was placed in charge of constructing the Khyber Railway in hostile tribal territory in north-western India, Bayley's base was inside a military camp.[41] The maintaining of a military character in the railway bureaucracies was a conscious strategy and assumed particular significance in decisions on Indianisation, as we shall we see later in this chapter.

Perhaps the most important feature of the railways' Superior Services, from a political point of view at least, was their racial composition. The Superior officer positions, both on state railways and company-run railways, were dominated by Europeans. Anglo-Indians, despite their large presence in the railways as a whole (around 11,000 employees in the 1920s, according to

[37] *India Office List* for 1913.
[38] Railway Board, *History of Services of the Officers of the Engineer and State Railway Revenue Establishments, Corrected to 1st July 1910* (Calcutta: Superintendent Government Printing, India, 1910), pp. 5-6. APAC: IOR/V/12/67.
[39] *Indian Railway Gazette*, March 1930, p. 79.
[40] Omar Khalidi (ed.), *Memoirs of Cyril Jones: People, Society and Railways in Hyderabad* (New Delhi: Manohar Publications, 1991), p. 52.
[41] Victor Bayley, *Nine Fifteen From Victoria* (London: Robert Hale & Company, 1937), pp. 222-4, p. 236, and p. 282.

one estimate),[42] were a minor presence in the Superior Services. In 1913, of 447 officers on the state railways drawing a salary of Rs. 200 per month or more, only 45 were 'native' Indians and 72 Anglo-Indians, a combined share of 26.17 per cent. The higher the salary bracket, the more heavily European-dominated were the posts:

***Table 5.2**: Salaries of Superior Officers, State Railways, 1913*

Salary per month	**Europe-ans**	**Indians**			**Total officers**	**Anglo-Indians (%)**	**'Native' Indians (%)**	**'Natives' + Anglo-Indians (%)**
		Anglo-Indians	Other ('native') Indians	Total				
≥ Rs. 200	330	72	45	117	447	16.11	10.07	26.17
≥Rs. 500	257	42	19	61	318	13.21	5.97	19.18
≥Rs. 800	155	17	11	28	183	9.29	6.01	15.30

***Source**:* Based on tables in *Islington Commission Report*, pp. 24-5.
Note: The category of 'native' Indians here includes Burmans, while the absence of a category for Domiciled Europeans in the source suggests that they are counted along with the Anglo-Indians.

Not only did Europeans form an overwhelming majority in the higher officer positions, they were also—as Chapter 4 showed for the PWD—paid higher salaries and offered greater benefits than their Indian counterparts. In the 1910s, the scale for the Imperial Service (mostly Europeans) in the ranks of Assistant Engineer and Executive Engineer began at Rs. 380 a month and went up to Rs. 1,250. The corresponding figures for the Provincial Service (recruited in India) were Rs. 250 and Rs. 900.[43] Even after the Imperial/Provincial distinction was eliminated and new pay scales put in place (1920-1),[44] engineers of 'non-Asiatic domicile' were paid a substantial overseas allowance *beginning* at Rs. 150 per month—as was the case in other All-India and Central Services. Other privileges applied across the services, including a number of paid passages to England, and arrangements for European officers and their families to be attended by European doctors.[45] Similar disparities are likely to have been present on the

[42] Frank Anthony, *Britain's Betrayal in India: The Story of the Anglo-Indian Community* (Bombay: Allied Publishers, 1969), p. 95.
[43] Annexure XVIII, *Islington Commission Report*, esp. p. 333.
[44] Railway Board, *Railways in India: Administration Report for the year 1920-21*, Vol. I, p. 31.
[45] *East India (Civil Services in India). Report of the Royal Commission on the Superior Civil Services in India* (Cmd. 2128, London: HMSO, 1924), pp. 29-31, pp. 35-6, and p. 53. This source is hereinafter cited as *Lee Commission Report.*

company-run lines, whose personnel policies, as we have seen, closely mirrored those of the state railways.

From the 1910s, nationalist politicians demanded two types of reform in the railways: first, in the way they were managed, and second, in the composition of their officers. These form the focus of the next two sections.

Nationalisation: demands and response

The seeds of debate about the ownership and management of India's railways had been sown in the late nineteenth century, when the original contracts of some of the railway companies with the Government of India had run their course. The Government bought these companies' assets, but invited the companies to continue managing the railroads in question.[46] In the early decades of the twentieth century, the anomalies created by this system began to provoke protests.

Some of these anomalies were related to macro-economic policy. In 1916 Sir Guilford Molesworth, former Government Consulting Engineer for state railways, argued that having a mix of state- and company-managed railways was inimical to the country's economic interests. The railway companies, he said, operated solely to maximise the profit of their shareholders and not to aid economic activity in India. They set very high rates for freight traffic, and where goods had to pass through the territories covered by their lines, Indian export trade was adversely affected.[47]

But the main protests against company management came from Indian thinkers, who did not feel that the railways were adequately representative of the interests of the Indian public.[48] A pamphlet circulated by a solicitor of the Bombay High Court, Faredun K. Dadachanji, in 1920 discussed the various reasons why Indians opposed the system of company management. They felt that the Railway Board was partial to the interests of the companies; that Railway Board officials went on to become directors on the boards of the railway companies upon retirement, causing a potential conflict of interest; that Third Class passengers and those on pilgrimage specials were ill-treated and transported in the worst possible conditions; and that Indians were kept out of the well-paying jobs on the company railways. In sum, 'Company management of the railways already owned by the nation' was '[a] most monstrous and a most insane doctrine'.[49]

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[46] See Kerr, *Engines of Change*, pp. 75 and 77.
[47] Guilford L. Molesworth, *Indian Railway Policy* (Indian Railway Series No. 1, compiled and edited by Faredun K. Dadachanji) (Bombay: F.K. Dadachanji, 1920), especially pp. 1-2.
[48] Kerr, *Engines of Change*, p. 113.
[49] Dadachanji, 'Compiler's Introduction' in Molesworth, *Indian Railway Policy*, pp. ix-xlii. The quoted text is from p. xlii. As the other two categories of railways—lines owned *and* run by companies, and lines

Discontent about the administration of the railways (especially the company-run lines) peaked in the aftermath of World War I, the stresses of which placed the railways in an economically precarious condition. Trains had to take on unprecedented freight loads, locomotives were despatched for use in theatres of war in Iraq, and (as discussed in the next chapter) the Indian-owned Tata Iron and Steel Company stepped in to supply steel rails to the government at special prices. By 1920 'Indian opinion on the question of state management of railways was unanimous and the demand for state management was reinforced both on political and economic grounds.'[50] Political, because state-run railways would be more 'Indian' than British-company-run ones; and economic, because initiatives on the scale required for the post-war repair of the railways' fortunes could only come from the state.

In November 1920 a committee was set up under the chairmanship of Sir William Acworth (a lawyer who had sat on the 1916 Royal Commission on Canadian Railways) to look into the issue. Foremost among the terms of reference of the Acworth Committee was to recommend what system of management would work best for the company-run (but state-owned) railways when their contracts with the government came to an end. The most immediate case was the East Indian Railway Company, whose contract had been due to end in 1919 and was subsequently extended to 1924.[51] The Committee was to assess 'the relative advantages, financial and administrative' of management by the state and management by a company (domiciled in England, India, or a combination of the two). The ten-member Committee (seven British and three Indian members) was also charged with suggesting ways to streamline the structure and working of the Railway Board and methods of raising the funds necessary for the running of the railways in India.[52] According to the evidence placed before the Committee, there was a chronic shortage of funds available for maintenance work, let alone fresh construction. This was primarily a result of the fact that the railways did not have an independent budget, and a reorganised Railway Board would enable the separation of railway finances from the government's general budget.[53]

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in the princely states—accounted mostly for the smaller, economically less important networks, the debate was not particularly concerned with them.

[50] Headrick, *Tentacles of Progress*, p. 85; Kerr, *Engines of Change*, p. 115 and p. 120; *Acworth Committee Report*, p. 19; Natesan, *State Management & Control of Railways*, pp. 11-12, including footnote 15 on p. 12. The quote is from Natesan, p. 12.

[51] *Acworth Committee Report*, p. 3. Most railway companies had begun in the mid-nineteenth century as guaranteed companies (the colonial government guaranteed them a minimum of 5 per cent return on investment per annum) on contracts lasting 50 or 60 years. The Government had a right to buy the assets of these companies after about 25 years, which they did, though in most cases they asked the concerned company to continue managing the railway. *Acworth Committee Report*, pp. 60-1 (Paragraphs 187-190).

[52] *Acworth Committee Report:* 'Terms of Reference' [front matter] and p. 3.

[53] *Ibid*., pp. 20 and 36.

At the end of their enquiry, the members were unanimous in concluding that the management of Indian railways should not be carried out from London. The directors of the railway companies in London might have 'technical and expert knowledge', but they were far removed from the actual field of operation, and would not find it easy to keep abreast of 'the modern social and trade conditions of India.'[54] But the Committee was divided upon the issue of who should actually be allowed to manage the railways. Five members, including the Chairman (generally referred to as the majority, as the Chairman had the casting vote), recommended the taking over and managing by the state (nationalisation) of these lines. The remaining five were in favour of setting up railway companies with Indian domiciles to run the state-owned railways.

The majority included the Chairman (William Acworth), V.S. Srinivasa Sastri (Member of the Viceroy's Council of State), E.H. Hiley (formerly of the British and later New Zealand Government Railways), Purshotamdas Thakurdas (representing Indian business interests), and James Tuke (Director of Barclays Bank and of the British Linen Bank). They began by arguing that under the existing system companies had no real autonomy, for they managed railroads they did not own, and were subject to government control via the Railway Board. They did not feel that railway officers could function efficiently 'with a divided allegiance to the board of directors which appoints and pays them, and to the Government authority which stands behind the directors'. On the other hand, they had found that the managements of state railways were as dynamic and open to 'new methods' as company-run railways. On another note, the members in the majority laid great stress on the importance of respecting Indian public opinion, which was 'practically unanimous' in favour of management directly by the state. They pointed out that Indian taxpayers had funded the building of the railways; that the Indian public were their main customers; and that the Legislative Assembly in Delhi was the body that approved the railway budget. In any case, they did not want to antagonise the masses: even if state management did not result in an improvement, they argued, 'we are quite sure that its failures would be judged more leniently by the Indian public.'[55] The railways, in this view, were more a public good than a set of commercial enterprises.

The minority was made up of Sir Henry P. Burt (Chairman of two railway companies and a former President of the Railway Board), Sir Rajendra Nath Mookerjee (Calcutta-based engineer-businessman), Sir Arthur R. Anderson (Railway Board President, 1919-20), Sir George C. Godfrey (Agent of the Bengal-Nagpur Railway Company), and Sir Henry Ledgard (representing European business interests in India). They saw democracy as a threat to the

[54] *Ibid.*, p. 64.
[55] *Ibid*., pp. 65-73.

business-like running of the railways. The railways, they felt, were 'primarily commercial undertakings' that should be run by companies 'so as to secure economy and efficiency'. Following the Montagu-Chelmsford reforms of 1919, which (as outlined in Chapter 2) had expanded the representative element in the provincial and imperial legislatures, the popular element in government had increased. Burt and his colleagues felt that the new political situation would accentuate the risks inherent in state-run railways. As the process of democratisation advanced, India '[would] be faced with the dangers which lurk in the handling of a commercial business through the agency of a State service and which experience elsewhere condemns.' In particular, the Committee's minority were concerned that state management would lead to inflexibility: for instance promotions might be made based solely on seniority without considering candidates' 'efficiency or local knowledge'.[56]

The trade journals that catered to senior European railway officers reflected these officers' view of the railways as businesses, and their abhorrence of the intrusion (as they saw it) of political considerations into railway policy and administration. The British-based *Railway Gazette*, reviewing the Acworth Committee Report, poured scorn on the members supporting nationalisation, asking if it would at all be possible to 'infuse and maintain in a Government department a spirit which Government departments rarely possess – a commercial spirit?'[57] Another journal, the *Indian Railway Gazette*, lamented the fact that the railway companies had not done enough to press their case against nationalisation. 'The whole question, by a skilful handling of the Indian Press, has been turned into a political affair, and once on that field of debate the matter became more than a one-sided question, seeing that the preponderating influences in the Assembly are Indian.'[58] In other words, political considerations were external and irrelevant influences that would cloud the issue. The question should be decided on the basis of business principles: what would make the railways more profitable?[59] The reference to 'preponderating [Indian] influences' also betrayed a fear that qualified European men of business and technical experience would be outvoted by uninformed Indian politicians.

In this climate of establishment opinion, William Acworth felt the need to clarify his reasons for supporting nationalisation. In a letter to the *Times*, he insisted that while his Indian colleagues Srinivasa Sastri and Purshotamdas Thakurdas 'were doubtless much influenced by the almost unanimous Indian opinion in favour of direct State management . . . the decision of

[56] *Ibid.*, pp. 73-5.
[57] *The Railway Gazette*, 21 October 1921, pp. 611-2.
[58] *Indian Railway Gazette*, April 1923, p. 108.
[59] A similar point was made by Sir Thomas Catto, speaking at the half-yearly general meeting of the Bengal Coal Co. Ltd., Calcutta, on 21 December [1922]. The address was reprinted in the *Indian Railway Gazette*, February 1923, pp. 47-8.

my two English colleagues and myself was mainly based on different grounds.' Acworth wrote that he had merely chosen the lesser evil in the circumstances:

> the actual choice being between companies with no freedom of initiative, bound to refer and defer on every occasion to their owner and master the State, and direct State management, I unhesitatingly voted for the latter.[60]

In any case the die was cast; the Legislative Assembly in Delhi endorsed the majority recommendations of the Acworth Committee, and nationalisation began. In 1925 the state took over two of the largest company-run lines, the East Indian Railway (EIR, based in Calcutta) and the Great Indian Peninsula Railway (GIPR, based in Bombay).[61] The government repeated the process when each company's contract came to an end; by 1944 nearly all the railways in India had been nationalised.[62]

Indianisation: demands and response

Indian politicians saw nationalisation as a way to hasten the Indianisation of the railways, but the demand for Indianisation had its own wider context and history. As early as 1878-79, a Select Committee of Parliament had suggested employing fewer Europeans as a way to make the maintenance of state railways more economical, but the railways were reluctant to do this.[63] In the twentieth century, as outlined in Chapter 2, political factors were added to the economic in arguments for Indianisation of the public services: gradual electoral reform increased the powers of Indian politicians. Their demands for greater training and employment opportunities for Indians resulted in several government enquiries into the Indianisation question.[64]

The Islington Commission (set up 1912; report published 1917) suggested varying measures to increase opportunities for Indians in different departments of the railways. For Engineering, they recommended a system of dual recruitment in England and India in equal proportion. In the Traffic Department Europeans might be selected from among Royal Engineer

[60] Quoted in *Indian Railway Gazette*, April 1923, p. 124.
[61] *Report by the Railway Board on Indian Railways 1924-25*, Vol. I (Calcutta: Government of India Central Publication Branch, 1925), pp. 4-5.
[62] Kerr, *Engines of Change*, p. 121.
[63] Headrick, *Tentacles of Progress*, p. 322.
[64] See Aparna Basu, 'Technical Education in India, 1854-1921', in Aparna Basu, *Essays in the History of Indian Education* (New Delhi: Concept, 1982), pp. 39-59, here p. 52; John F. Riddick, *The History of British India: A Chronology* (Westport, Conn.: Praeger, 2006), p. 94 and pp. 100-101.

officers, and for the rest preference should be given to qualified candidates from India. In the almost entirely European departments of Locomotive and Carriage & Wagon, the railways should groom (Indian) subordinates for promotion, and invest in developing institutions to provide training, a potential locus for which already existed in the country's many railway workshops.[65]

The Acworth Committee of 1920-1 also touched upon Indianisation in its report on the question of nationalisation of the railways. Its members continued the Islington Commission's emphasis on the need for new training facilities for the Traffic and Mechanical Engineering (Loco, Carriage & Wagon) Departments. They suggested that the government set a target of a certain percentage of Indians within a specified time-frame (though they did not themselves specify any numbers).[66]

The Lee Commission of 1923-4, whose task was 'to accelerate Indianisation' while simultaneously maintaining a European component to prevent any abrupt change in the character of the services,[67] recommended that recruitment for the Superior Services of the state railways continue to be conducted both in England (by the Secretary of State) and in India (by the central government).[68] Their specific recommendations on Indianisation targets were as follows:

> *State Railway Engineers.--Superior Revenue Establishment, State Railways.*--We understand from the evidence placed before us that the present rate of recruitment (taking an average over the departments as a whole) has been designed with a view to securing, *as soon as practicable*, a cadre of which, out of every 100 officers, 50 shall have been recruited in India and 50 in Europe. The date at which this cadre may be reached is, we are informed, dependent on the provision of adequate training facilities in India. Measures with that end in view were advocated by the Islington Commission and we are informed that facilities have already been provided to a limited extent. We are strongly of opinion that the extension of the existing facilities should be pressed forward as expeditiously as possible in order that recruitment in India may be advanced *as soon as practicable* up to 75 per cent. of the total number of vacancies in the railway departments as a whole, the remaining 25 per cent. being recruited in England.[69]

[65] *Islington Commission Report*., pp. 22-3; Annexure XVIII, *ibid.*, pp. 328-9; Annexure XIX, *ibid.*, pp. 338-9.
[66] *Acworth Committee Report*, p. 58.
[67] *East India (Civil Services in India). Report of the Royal Commission on the Superior Civil Services in India* (Cmd. 2128, London: HMSO, 1924), p. 1 and pp. 4-6. The quoted text is from p. 6. This source is hereinafter cited as *Lee Commission Report*. Indianisation was already taking place, but '[i]n Indian political circles . . . the rate of Indianisation adopted since 1919 was regarded as illiberal.' *Ibid*, p. 6.
[68] *Ibid*., p. 10.
[69] *Ibid*., p. 23, paragraph 42d. Emphasis mine.

Thus for every officer recruited in Britain, three must be recruited in India. This applied to the Superior Services of the state railways 'as a whole', i.e. across all its departments. This ratio, and the larger aim of an overall staff proportion of 50-50, were to be arrived at 'as soon as practicable' rather than within a set time-frame.

One point is crucial in the translation of this recommendation into policy: the figure of 75 per cent was taken to refer to *Indians*, rather than officers recruited *in India*. As we shall see in the next section, government reports in the following years gave statistics showing employees categorised as European or (statutory) Indian, rather than on the basis of where they had been recruited. (In any case most statutory Indians would have been recruited in India and Europeans in England.) This interpretation was confirmed as government policy. In a speech in 1924 the Viceroy said, referring to a recent debate on railway finance in the Legislative Assembly, that

> [t]he Lee Commission had made recommendations on this question [Indianisation] … and before the debate on railway finance in the Assembly, the Government of India had decided to accept these recommendations which have the effect of pressing forward as rapidly as possible the extension of existing facilities in order that "the recruitment *of Indians* be advanced as soon as practicable up to 75 per cent. of the total number of vacancies in the railway department as a whole."' [70]

Significantly, the 75 per cent formula was also accepted by the company-run railways.[71] In the following decades the Lee prescription of 3:1 recruitment was used as the definitive benchmark against which to measure Indianisation.

Mutual mistrust on Indianisation

Although Indianisation targets for the railways had received the government's seal of approval, European sections of the railway community were apprehensive, questioning Indians' readiness for responsible positions in terms of their competence and loyalty. This reaction was similar to the PWD case, although the reasons—implicit and explicit—given for it in the railways were slightly different. Chapter 4 showed that Indians' gentlemanliness, courage and other non-

[70] Appendix F: 'His Excellency the Viceroy's address to the Indian Railway Conference Association at the opening of the 1924 session', in *Report by the Railway Board on Indian Railways for 1924-5*, Vol. I (Calcutta: Government of India Central Publication Branch, 1925), pp. 101-5, here p. 104. Emphasis mine.

[71] C.A. Innes to A.K. Acharya, in *Extracts from the Debates in the Indian Legislature on Railway Matters, Delhi Session – January to March 1927* (Calcutta: Government of India Central Publication Branch, 1927), p. 118. APAC: IOR/V/25/720/45. L.A. Natesan's 1946 study adds that the Lee Commission's 'Concessions' (i.e. recommendations on pay and leave) 'were faithfully copied on company-managed railways.' Natesan, *State Management & Control of Railways*, p. 386.

technical attributes were questioned. In the railways, two main parameters were used in the debate on employing more Indians: first, their 'efficiency', which was never clearly defined, but appeared to refer to a mix of technical and non-technical attributes; and second, their 'loyalty', i.e. whether or not their political sympathies lay with the colonial state.

The concern with 'efficiency' was a long-standing one. That Indians lacked the aptitude and temperament required for railway work was a stereotype current in the nineteenth century;[72] it was still present in the twentieth. It was clearly visible in the railway press, a vivid example being a series of drawings that originally appeared in the Great Indian Peninsula Railway Magazine and were collected in a 1921 book, *The Koochpurwanaypore Swadeshi Railway.*[73] The satirist, working under the pseudonym of 'Jo Hookm' ('as you command'), presented his vision of what might happen if the railways were to be completely indigenised. In one of the drawings, an Indian Chief Engineer, 'Mr. Sleeper Rastaji', is shown in his office.[74] Measuring instruments and an incomplete blueprint languish in the background, while the dissolute engineer lounges on the floor, hookah in hand, entertained by minstrels and dancing girls. The cartoonist saw the Indian engineer as not only weak of character, but also as incapable of grasping the basic principles of construction: another drawing shows workmen erecting a bridge that the fictional 'K.P.R. [Koochpurwanaypore Railway] Bridge Engineer has designed … on the quite novel principles, being a combination of the Cantilever, Truss and Suspension all rolled into one. (Patent applied for.)'[75]

A similarly disdainful pronouncement came from a visiting American engineer who wrote to the *Indian Railway Gazette* (a magazine whose articles were usually aimed at the European section of the railway community) in 1923. He was impressed by the young (European) railway employees he had come across, but felt they were under threat of being swamped by incompetent Indians if they tried to 'cut in by too much of this Indianisation.' Indians were 'peculiarly lacking' in the 'instinct' required for running the railways (the writer did not specify what this instinct was).[76] The *Gazette*'s editorial view of Indians was in subtle agreement with this. Commenting in 1930 on debates on the railways in the Indian Legislative Assembly, the magazine spoke of the need for the Railway Board to keep the 'balance' between efficiency and Indianisation—implying that the one could only be achieved at the expense of the

[72] See Manu Goswami, *Producing India*, Chapter 3; Headrick, *Tentacles of Progress*, Chapter 9; and Derbyshire, 'The building India's Railways', p. 184.
[73] 'Jo Hookm', *The Koochpurwanaypore Swadeshi Railway*, 2nd edn (Calcutta and Simla: Thacker, Spink & Co; Bombay: Thacker & Co Ltd, [1921]).
[74] *Ibid.*, p. 22.
[75] *Ibid.*, p. 29.
[76] *Indian Railway Gazette*, December 1923, pp. 445-6.

other. This balance, it opined, had thus far been 'held with splendid British impartiality and fair play'.[77]

In addition to such prejudices, the equation of Indianisation with inefficiency may partly be ascribed to senior engineers' and managers' lack of confidence in the facilities available to Indians for technical training in railway work. For railway engineers in particular, having some practical experience prior to receiving an appointment was seen as essential. As we saw earlier in this chapter, most British engineering recruits had already had some experience on British railway lines. On the other hand Indian graduates, whether of Indian or British engineering colleges, '[had] difficulty in obtaining that initial practical experience which is an essential complement to their college course before they can be considered competent to practise as engineers.'[78] That this applied also to Indians in Britain was not unusual: the Indian Industrial Commission (1916-18) had observed that Indian students seeking practical experience in Britain were usually turned down.[79]

The second argument against Indians was closely related to the military character of the railways, referred to earlier. This was that Indians' loyalty to the colonial regime was suspect. The equation of the railways with the security of Britain's Indian empire, both internal and external, was an acknowledged article of policy. The Secretary to the Railway Board had told the Islington Commission (1912-15) that the railways were 'a necessary factor in maintaining the security of the country'.[80] Earlier in this chapter I referred to the conspicuous presence of Royal Engineer officers in the Engineering and Traffic Departments: this was a way of ensuring that the strategically important railways remained in the control of combat-ready officers loyal to the colonial government. Official reports said as much, directly or indirectly. In recruiting for the Traffic Department, for example, it was essential 'owing to considerations of policy', 'to maintain a nucleus of officers imported from Europe', a solution to which was 'the appointment in India of Royal Engineer officers.'[81] In the 1920s, Indianisation notwithstanding, recruitment in England by the Secretary of State could not be terminated for 'those *quasi* security Services, the Railways, the Telegraph Engineers, the Customs, and Political . . . [which] are the Central Services upon which the military security and commercial credit of the country depend.'[82]

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[77] *Indian Railway Gazette*, April 1930, p. 123.
[78] *Statement of Moral and Material Progress of India*, 1926-7, pp. 173-4.
[79] Indian Industrial Commission, 1916-18, *Report* (Calcutta: Superintendent Government Printing, 1918), p. 107. According to the IIC, an earlier enquiry had suggested that the industries in which Indians sought apprenticeships were wary of '[assisting] possible competitors'. *Ibid*.
[80] Quoted in Hirday Nath Kunzru, *The Public Services in India (Political Pamphlets—II)* (Allahabad: Servants of India Society, 1917), p. 149.
[81] Annexure XIX, *Islington Commission Report*, p. 338.
[82] 'Minute by Sir Reginald Craddock upon certain of the conclusions of the commission', *Lee Commission Report*, pp. 127-38, here p. 135.

Among the chief concerns of British parliamentarians debating Britain's policy in India was the maintaining of a minimum quota of Anglo-Indian employees (in all grades) on the Indian railways, which would allow the raising of auxiliary forces loyal to the colonial government in the event of rebellion.[83] Indianisation, in their view, would reduce the government's sources of military manpower and make the railways, and in consequence the empire, susceptible to sabotage.[84] Speaking in the House of Commons in 1933, the Duchess of Atholl (the Conservative MP for Kinross and West Perthshire, whose contribution to a different debate was quoted in Chapter 4),[85] drew attention to 'the need for securing a disciplined British reserve for the management of the railways, in case there should at any time be a failure of the Indian staff to run the railways efficiently and loyally.' This reserve staff must contain Britons capable of fulfilling the roles of subordinates as well as officers. Following the Punjab unrest of 1919, the Duchess said, the Government of India began to train annually a number of Royal Engineer 'officers and men', 'in the management of locomotives on the Indian railways'. But that practice had not been continued in recent years. The Duchess asked if 'with a decreasing number of Europeans and Anglo-Indians on the staff of the railway, and without any of the trained British reserves to man the locomotives, the defences of that great country [could] be adequately secured.'[86]

In the light of such views, it is not surprising that nationalists in the Legislative Assembly in Delhi were unconvinced by the government's undertakings with respect to Indianisation. They questioned the representatives of the Railway Board minutely, especially on whether they were meeting the Lee Commission's target (75 per cent Indian recruitment for the Superior Services). The Board repeatedly assured members of the Legislature that the Lee Commission's recommendations were being implemented. Sir Charles Innes, Railway Member

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[83] As shown by some of the arguments in 'Clause 231.—(Application of preceding section to railway services, and officials of courts.)', House of Commons Debate, 4 April 1935, vol. 300, cc. 547-81 (Hansard).

[84] See also David Campion's detailed account of the role of the railway police, in which he mentions the use of auxiliary forces made up of Europeans and Anglo-Indians working in the railways. David A. Campion, 'Railway Policing and Security in Colonial India, c. 1860-1930', in Roopa Srinivasan, Manish Tiwari and Sandeep Silas (eds.), *Our Indian Railway: Themes in India's Railway History* (New Delhi: Foundation, 2006), pp. 121-53, esp. p. 147.

[85] 'Stewart-Murray, Katharine Marjory, duchess of Atholl', *Concise Dictionary of National Biography*, Oxford University Press, March 1992 (via http://www.knowuk.co.uk, accessed 29 January 2011).

[86] 'India Office', House of Commons Debate, 17 July 1933, vol. 280, cc. 1549-608, here cc. 1607-8 (Hansard). While the Duchess's intervention is quoted here to show the establishment's attitude towards Indian employees, her fears were ill-founded in statistical terms. Although she was right about the fall in European numbers overall, the combined share of Europeans/Domiciled Europeans/Anglo-Indians in the Loco and Carriage Departments as of 1933 was still extraordinarily high: 84.35 per cent of officers and 82.28 per cent of Upper Subordinates. Appendix F, *Report by the Railway Board on Indian Railways for 1933-34*, Vol. I (Delhi: Manager of Publications, 1934) and Appendix G, *Report by the Railway Board on Indian Railways for 1924-25*, Vol. I (Calcutta: Government of India Central Publication Branch, 1925).

of the Governor-General's Council, told A.K. Acharya in 1927 that regulations had been published for the recruitment in India of superior service officers in the state railways' Engineering and Transportation departments, and that competitive examinations had been held in November of the previous year. Regulations for Signal and Bridge Engineering were 'under consideration' (as we observed earlier, these positions were virtually all held by Europeans).[87]

Distinctions in pay between British and Indian engineers were also questioned. Lt.-Col. H.A.J. Gidney, a prominent representative of the Anglo-Indian community,[88] asked A.A.L. Parsons (Financial Commissioner of the Railway Board) in 1930 if there was no fixed starting salary for officers recruited as signal engineers in England, and whether all such officers were recruited on higher starting salaries than those selected in India. Parsons replied that 'there is a fixed incremental scale of pay for Engineers but Government reserve the right to appoint officers whether recruited in England or in India, having regard to their age and qualifications, on initial rates of pay higher than the minimum of the prescribed scale.' To the second part of the question, the reply was 'in the negative'.[89] On other occasions the scrutiny resulted in tense exchanges. When B. Das asked in 1926 if Government would implement 'their promise to this House of 75 per cent. Indianization' in selection—specifically of engineers—in England and in India, Innes replied: 'I should not have thought it necessary for the Honourable Member to ask that question, because when Government give a promise, they invariably carry it out.'[90]

Through the 1920s and 1930s the government certainly made efforts to show that they were attempting to keep their 'promise', furnishing statistics on Indianisation in annual reports. But did they actually keep it, or was the Indian politicians' scepticism justified? What was the result of the tug-of-war between political pressure in the Legislative Assembly and opinion in sections of the railway bureaucracy? To answer these questions it is necessary to examine the numerical progress of Indianisation of the railways' Superior Service, the measures taken by the government to provide new facilities for training, and the priorities it revealed in the process.

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[87] C.A. Innes's reply to B. Das, in *Extracts from the Debates in the Indian Legislature on Railway Matters: Delhi Session – January-March 1926* (Calcutta: Government of India Central Publication Branch, 1926), p. 80 (APAC: IOR/V/25/720/44**)**; C.A. Innes to A.K. Acharya, in *Extracts from the Debates in the Indian Legislature on Railway Matters, Delhi Session – January to March 1927* (Calcutta: Government of India Central Publication Branch, 1927), p. 118 (APAC: IOR/V/25/720/45).

[88] On Gidney's role in representing Anglo-Indians, see Anthony, *Britain's Betrayal in India*, p. 87ff.

[89] Printed in the *Indian Railway Gazette*, May 1930, p. 194.

[90] *Extracts from the Debates in the Indian Legislature on Railway Matters: Delhi Session – January-March 1926* (Calcutta: Government of India Central Publication Branch, 1926), p. 20. APAC: IOR/V/25/720/44.

The extent of Indianisation, 1920-40

In assessing the extent of Indianisation in the 1920s and 1930s, I use statistics compiled from two main sources: the annual administration reports of the Railway Board, and the *Statement Exhibiting the Moral and Material Progress and Condition of India*, tabled each year in the British Parliament by the India Office. I also base qualitative observations on a perusal of government and commercial employment lists.[91] An assessment of the training facilities introduced in this period (especially for Indians) is made on the basis of the qualitative sections of the Railway Board's annual Administration Reports.

In understanding the progress on Indianisation in statistical terms, two different measures are important. One is the *composition* of the Superior Services in a given year: i.e., what percentage of officers on the rolls were Indians? The other measure is *fresh recruitment*: what percentage of officers recruited each year were Indians?

In the following analysis, I will use two reference points. The first is the government's *recruitment* target of 75 per cent Indians: which, as we saw, was applied to both state and company railways. The second is the 50 per cent *composition* target. Here I make the assumption that, as in the case of the recruitment target, the Lee Commission's original formulation of 'recruited in India' was taken to refer to Indian officers, i.e., the longer-term goal was to reach a stage when 50 per cent of Superior Service officers were Indian. This is supported by the fact that the staff and recruitment figures published in official documents under the head of 'Indianisation' did not show place of recruitment. For the same reason it is also a viable benchmark in this analysis. Finally, following Railway Board reports, I take Indianisation to mean the increasing presence of all statutory Indians: that is, I include Anglo-Indians and Domiciled Europeans (in addition to 'native' Indians) in calculations of the Indian share in the Superior Services.

The composition around the time the Lee Commission's recommendations were made is illustrated by Table 5.3, showing the percentage share of Indian Superior officers by department on the state railways and the company-run railways in 1925. In these figures state railways include the newly nationalised (in January 1925) East India Railway, but not the Great Indian Peninsula Railway, which was nationalised later that year.

[91] *India Office List* and *Thacker's Indian Directory*. The former of these sources refers to an annual publication of the India Office in London, listing the officers appointed to the various all-India government services. The latter was a commercial almanac produced annually by Thacker, Spink & Co., a Calcutta publishing firm. Continuous series of both publications are available on the open shelves of the APAC.

Table 5.3: *COMPOSITION.*[92] *Extent of Indianisation, Railway Superior Service officers, as of 1st April 1925*

	Department	*State Railways, numbers* ***(Indians/Total)***	*State Railways, Indians as %*	*Company-run Railways, numbers* ***(Indians/ Total)***	*Company-run Railways, Indians as %*	*Overall, numbers* ***(Indians/ Total)***	*Overall, Indians as %*
		Column 1	*2*	*3*	*4*	*5*	*6*
1	Agency	4/23	17.39	7/40	17.50	11/63	17.46
2	Engineering	100/303	33.00	72/435	16.55	172/738	23.31
3	Traffic	65/225	28.89	56/274	20.44	121/499	24.25
4	Loco and Carriage & Wagon (LCW)	7/109	6.42	7/166	4.22	14/275	5.09
5	Stores	8/32	25.00	5/43	11.63	13/75	17.33
6	Other Departments	45/110	40.91	39/171	22.81	84/281	29.89
7	Total	229/802	28.55	186/1129	16.47	415/1931	21.49

Note*:* Of the 1,931 officers (Col. 5), 87 were Anglo-Indians (4.51 per cent). These 87 are included in the total of 415 Indian officers.
Source: Based on Appendix G, *Report by the Railway Board on Indian Railways 1924-25*, Vol. I (Calcutta: Government of India Central Publication Branch, 1925), pp. 106-7.

The overall proportion of Indians in Superior positions was low: 21.49 per cent for all railways taken together. A 50 per cent Indian cadre was clearly a long way away in 1925. Of individual departments, the Agency, which constituted the managerial jobs, was less than one-fifth Indian, while the mechanical engineering jobs (Locomotive, Carriage and Wagon) were almost entirely European (only 5.09 per cent of its officers were Indian). The Indian proportions in Engineering and Traffic were comparable, around one-quarter in each case. Finally, it is evident that on the whole company-run railways had a lower proportion of Indians than the state railways.

With these as the base figures, the pattern of recruitment clearly had to be heavily in favour of Indian officers for the next several years in order to approach a 50-50 composition of Indians and Europeans. Table 5.4 shows the pattern adopted in fresh recruitment over the 1920s and 1930s.

[92] Figures in Table 5.3 and Table 5.5 below do not include the Nizam's Guaranteed State Railway (Hyderabad) and the Jodhpur Railway, both of them based in princely states.

Table 5.4: *RECRUITMENT. Indianisation—fresh recruitment to the Railway Superior Service, 1921-1941*
Figures in columns marked (*) show the percentage share of Indians among fresh recruits in a given year

Col 1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
YEAR	STATE RAILWAYS						COMPANY RAILWAYS	
	*Engineering**	*Traffic/ Transp (Commercial)**	*Mech / Transp (Power)**	*Other **	*Overall Superior Posts**	*Nos. recruited (Indians/ Total)*	*Overall Superior Posts**	*Nos. recruited (Indians/ Total)*
1921-2	66.7	100.0		11.1	65.6	21/32		
1922-3	60.0	100.0		23.1	47.8	11/23		
1923-4	71.4	-no recruitment-		14.3	52.4	11/21		
1925-6					32.0			
1926-7					62.0			
1927-8	78.0	36.0 (combined)		57.0	68.0		49.0	
1928-9					70.0			
1929-30	71.0	80.0	73.0	67.0	71.0		49.2	
1932-3					63.6	7/11	42.3	11/26
1933-4	No recruitment						59.3	16/27
1934-5					61.9	13/21	66.7	26/39
1936-7	66.7	75.0	100.0	100.0	85.7		69.6	
1941-2	100.0	87.5	100.0	100.0	95.5	21/22	97.3	36/37

Note*:* Empty cells indicate data not available/ not found.
Source: Railway Board's Administration Reports, *Statement of Moral and Material Progress*, various years.

The figures in Table 5.4 show that on the state railways until the mid-1930s, the percentage of Indians recruited as Superior officers was often in the range of 60 to 70 per cent (Column 6). Although this was a considerable proportion, it fell consistently short of the 75 per cent target. Although the data is not exhaustive, it appears that the highest percentage of Indians were recruited to the Traffic Department (Col 3), which fits with the government's focus on providing training in this area during these years (these measures are discussed below). The company-run railways, which had accepted the Lee Commission's recommendations, fell well below the 75 per cent mark, missing it by a larger margin than the state railways did (Col 8). Sometimes, as in 1933-4 during the Depression, no officers were recruited to the state railways. The last row, for the year 1941-2, shows a sudden jump to almost 100 per cent recruitment of Indians: this is because recruitment in Europe was suspended at the start of World War II.

To put these numbers in perspective, it must be emphasised that recruitment in terms of absolute numbers was very modest throughout the 1920s and '30s (see Columns 7 and 9). Clearly, then, fresh recruitment could only have a limited impact on changing the racial composition of the officer ranks (although other factors were at play—see the discussion of Table 5.5 below).

Table 5.5: *COMPOSITION. Extent of Indianisation, Railway Superior Service officers, as of 31st March 1934*

	Department	*State Railways, numbers* ***(Indians/ Total)***	*State Railways, Indians as %*	*Company-run Railways, numbers* ***(Indians/ Total)***	*Company-run Railways, Indians as %*	*Ry Board & misc. officers, numbers* ***(Indians/ Total)***	*Ry Board & misc. officers, Indians as %*	*Overall, numbers* ***(Indians/ Total)***	*Overall, Indians as %*
		Column 1	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1	Agency	11/37	29.73	9/35	25.71	0/1	0.00	20/73	27.40
2	Accounts	37/51	72.55	28/59	47.46	4/4	100.00	69/114	60.53
3	Engineering	151/335	45.07	82/254	32.28	3/11	27.27	236/600	39.33
4	Transportation	101/247	40.89	81/183	44.26	5/11	45.45	187/441	42.40
5	Commercial[93]	19/37	51.35	6/13	46.15	0/0	0.00	25/50	50.00
4+5	*Transp + Comm (=Traffic)*	*120/284*	*42.25*	*87/196*	*44.39*	*5/11*	*45.45*	*212/491*	*43.18*
6	Mech Engg (=LCW)	45/184	24.46	21/133	15.79	0/4	0.00	66/321	20.56
7	Stores	17/43	39.53	11/29	37.93	0/0	0.00	28/72	38.89
8	Other	38/91	41.76	23/67	34.33	12/31	38.71	73/189	38.62
9	Total	419/1025	40.88	261/773	33.76	24/62	38.71	704/1860	37.85

Note: Of the total of 1,860 (Col. 7), Anglo-Indians and Domiciled Europeans accounted for 125 officers (6.72 per cent). These 125 are included in the total of 704 Indian officers.

Source: Based on Appendix F, *Report by the Railway Board on Indian Railways for 1933-4*, Vol. I (Delhi: Manager of Publications, 1934), pp. 103-6.

[93] Figures for Commercial are included under Transportation for some Railways. Figures in this row refer to railways where separate figures are given for the Commercial Department.

Table 5.5 shows the composition of the Superior establishments of the railways as of 31 March 1934. Ten years after the Lee Commission's recommendations, the overall share of Indians in the Superior Services had risen from 21.49 per cent to 37.85 per cent. This suggests a significant advance in Indianisation, although the result was still considerably lower than the 50-50 composition that had been aimed at in the early 1920s: that target would only be met some years later (see below). The Indian share of particular departments (Engineering on the company railways, Mechanical Engineering on all railways) was still notably low. In Engineering too, the increase in the Indian share was at least partly due to the fall in the number of European officers by 202.[94]

In the Depression-hit early 1930s, the Railway Board began a policy of retrenchment. In 1932, for instance, it asked the state railways to reduce its officer cadre substantially, dissolved a number of posts on the company lines, and ended the services of several temporary engineers.[95] In these years the strength particularly of the European officers fell. Daniel Headrick has suggested that Depression-era conditions made the Indian railways an unattractive destination for potential British officers;[96] possibly some already serving Europeans took voluntary retirement, though it has not been possible to ascertain this. At any rate Tables 5.3 and 5.5 show that between 1925 and 1934, when the overall number of Superior officers dropped by 71 (from 1,931 to 1,860), the drop in the number of Europeans (as calculated from the same tables) works out to the much larger figure of 360. (The tables show that in the same period the net increase in Indian officers was 289.) Thus although the *recruitment* percentages followed (Table 5.4) contributed to the relative Indianisation of the railways, the leaving of European officers evidently contributed to the rise in Indians' percentage share overall.[97]

Finally, it should be noted that the Anglo-Indians and Domiciled Europeans formed only a minor component (well below 10 per cent) of the Superior Services throughout the 1920s and 1930s, although they did form a substantial proportion of (statutory) Indian officers. In addition, they were predominant among Upper Subordinates, i.e., subordinate employees with a monthly salary of Rs. 250 and above, or pay scales rising to that level.[98]

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[94] Their number was 738 - 172 = 566 in 1925 (Table 5.3); and 600 - 236 = 364 in 1934 (Table 5.5). Thus it fell by 566 – 364 = 202. See 'Overall numbers' column in each table.

[95] Natesan, *State Management & Control of Railways*, pp. 369-70. Kerr, *Engines of Change*, p. 130 also refers to retrenchment in the 1930s.

[96] Headrick, *Tentacles of Progress*, p. 343.

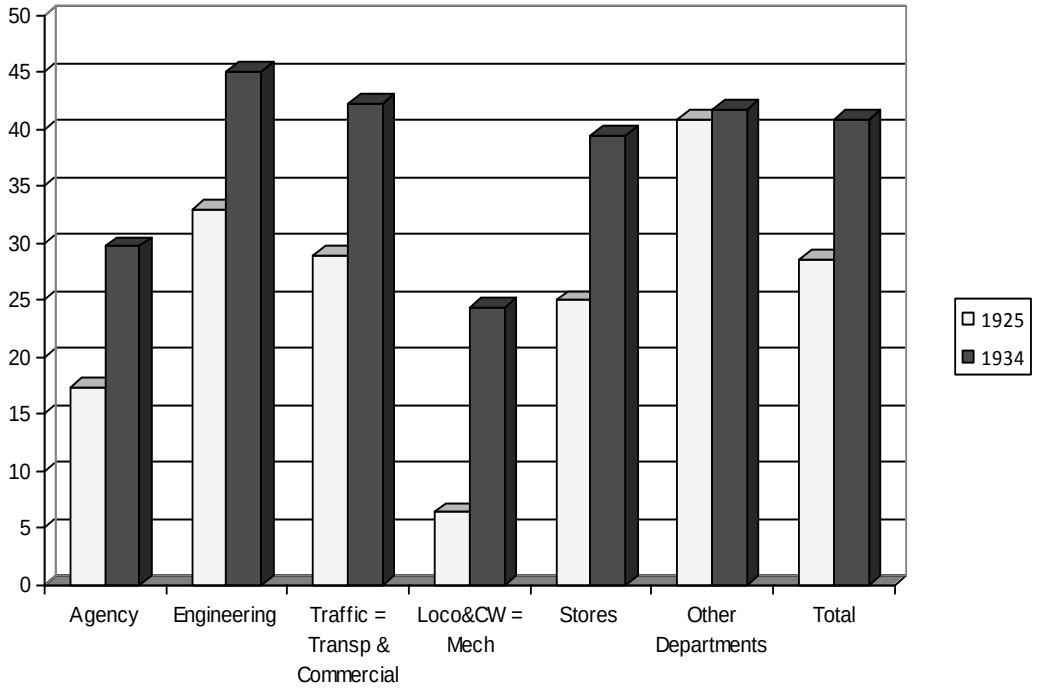
[97] Headrick, *Tentacles of Progress*, p. 343 suggests that Depression conditions and retrenchment boosted Indianisation in these years. However this is a general observation and is not based on Superior Service employment statistics.

[98] The percentage shares among Upper Subordinates in 1925 were: Europeans 35.84 per cent; Anglo-Indians 37.61 per cent; other Indians 26.55 per cent. In 1934 they were: Europeans 19.59 per cent; Anglo-

Figures 5.1 and 5.2, based on Tables 5.3 and 5.5, summarise the statistics presented on Superior Officers.

Figure 5.1: *State railways: Indians by percentage in each department of the Superior Services, 1925 and 1934*

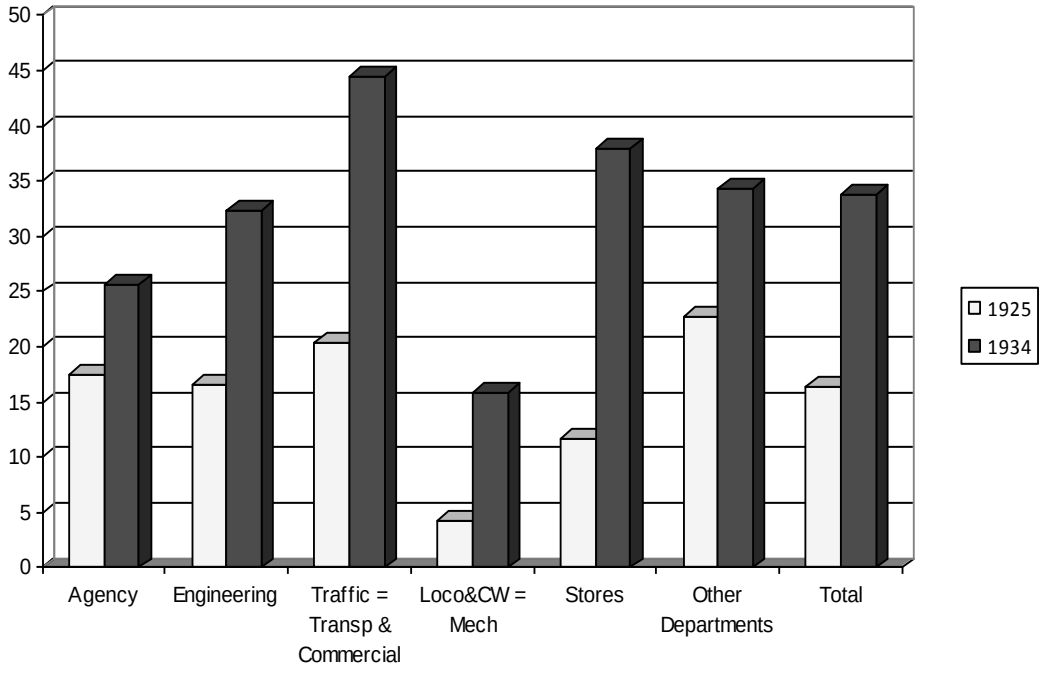
(Y axis shows Indians' percentage share of appointments in each department)
(Based on Tables 5.3 & 5.5)



Indians and Domiciled Europeans 42.00 per cent; other Indians 38.41 per cent. Appendix G in *Report by the Railway Board on Indian Railways for 1924-25*, Vol. I (Calcutta: Government of India Central Publication Branch, 1925) and Appendix F in *Report by the Railway Board on Indian Railways for 1933-34*, Vol I (Delhi: Manager of Publications, 1934). These figures are in general agreement with Daniel Headrick's observation that 'During and after World War I, the railways replaced many of their midlevel imported European personnel with resident Europeans and Eurasians.' Headrick, *Tentacles of Progress*, p. 342.

Figure 5.2: *Company-run railways: Indians by percentage in each department of the Superior Services, 1925 and 1934*

(Y axis shows Indians' percentage share of appointments in each department)
(Based on Tables 5.3 & 5.5)



The figures above show that the Indian presence grew in all departments across all railways; that their overall share on the state lines was always higher than on the company lines; that the most dramatic increase came in the company-run railways' Traffic Departments; and that while the Indian share in Mechanical Engineering increased, it was still the least Indianised of all departments in 1934. The charts also show that despite these developments, no department on either type of railway had attained a 50-50 composition of Indian and European Superior officers as of 1934.

In fact, it was only towards the end of the 1930s that Indians exceeded the 50 per cent mark in the Superior Services. The decisive increase in the Indian share came after the outbreak of World War II, when recruitment in Europe ceased, and many European officers left India to serve in the war.[99] Thus the departure of Europeans was a critical factor once again. The numbers under each department for these years have not been found, but the overall figures are shown in Table 5.6.

[99] See Kerr, *Engines of Change*, p. 119, pp. 130-1.

Table 5.6: COMPOSITION. Percentage share of Indians among gazetted railway officers[100] in the early years of World War II

	1941	**1942**
State railways	60.82	64.14
Company-run railways	5l.78	57.26
Overall	56.69	60.95

Source: *Report by the Railway Board on Indian Railways for 1941-2*, Vol. I, p. 30.

Thus the achievement of a 50-50 composition a full decade and a half after the Lee Commission came about not only by recruiting more Indians, but with the intervention of external factors (the Depression and World War II) that caused the exit of European officers from railway service in India.

Training Indians: non-uniform measures across departments

The high rate of recruitment of Indians to the Traffic Department (Table 5.4) and the relatively high Indian presence in that department in 1934 (Figures 5.1 and 5.2) point to a conscious effort to seek and train potential Traffic officers in India. This is corroborated by the qualitative sections of the Railway Board's annual reports in this period, which almost invariably mentioned facilities and schemes instituted for training current or potential Traffic officers. These sources also mention training schemes for Loco and Carriage officers, though to a lesser extent.[101]

From the early twentieth century, individual railways had various types of apprentice schemes to train employees for work. The various lines had permanent or temporary railway schools in different parts of the country, for example in Asansol and Jamalpur (on the East Indian Railway), Lyallpur and Walton, Lahore Cantonment (on the North-Western Railway) and Bina (on the Great Indian Peninsula Railway). These 'area schools' catered mainly to subordinates, with courses for Switchmen, Assistant Station Masters, Traffic Inspectors, and Rolling Stock operators. It appears that they obtained their students mainly from among the sons of railway employees with a basic school education.[102]

[100] This includes the Superior Service and a small 'Lower Gazetted Service', an intermediate officer level that was small enough that the Superior Service taken in isolation would have almost the same percentage figures.

[101] The following account of training facilities is based on issues of the *Statement exhibiting moral and material progress* and on the annual reports of the Railway Board, for various years between 1920 and 1940.

[102] For instance G.L. Colvin, Agent of the East India Railway (EIR), placed an ad in the *Indian Railway Gazette*, January 1923, p. 5, calling for European, Anglo-Indian and Indian candidates for subordinate posts in the Engineering Department of the EIR. Candidates had to be aged 16-20 and have passed the

In 1925 a school was set up in the northern town of Chandausi to coordinate the activities of the other schools, and to train probationary Traffic officers. After a few years, though, it confined itself to training subordinates, prompting the inauguration in 1930 of a Railway Staff College at Dehra Dun in the Himalayan foothills. The Railway Staff College was to cater primarily to Superior officers in the Transportation (Traffic and Mechanical) Department. Officers selected in India would spend a total of five months at the Railway Staff College as part of their training. In a profile of the new Staff College, the *Indian Railway Gazette* wrote: 'The training is ... practical and theoretical, and is in pursuance of the accepted policy of the Government of India to increase the number of Indians employed in the higher grades of railway work. Young Indian gentlemen [this probably refers to university graduates] who wish to adopt railway Transportation as their profession, have the satisfaction of knowing that, if they succeed in passing the initial examination, they can look forward to training in their profession probably unequalled anywhere else in the world.'[103] As it happened, the need to cut costs in the Depression years caused the Staff College to be shut in 1932. The Railway Board asked individual railways to prepare programmes of lectures for their officers, and went back to relying on the area schools on the various lines.

We have seen that Superior officers in the Loco and Carriage (Mechanical Engineering) departments were overwhelmingly British: recruitment depended not on college training but on practical skills gained in railway workshops, and the Indian railway workshops did not have systematic training facilities. In the 1920s attempts were made to address this deficiency. Among the more concrete measures taken was the East India Railway's (EIR) Special Class Apprentice (SCA) programme for candidates from across the country, in operation from the mid-1920s (around the time the EIR was nationalised). It was based in the Jamalpur workshop and the adjoining technical school. A description of this programme is found in the memoirs of Duvur Venkatrama Reddy, a Mechanical Engineering officer in the EIR (and, after Independence, Indian Railways). Reddy, a student at Presidency College in Madras, was among twelve matriculates selected from all over India for the programme in 1930. He underwent four years' training at Jamalpur, followed by two years in England in railway workshops at Ashford and Eastleigh before returning to join the EIR's Superior Service.[104]

Junior Cambridge or equivalent exam (if they were European or Anglo-Indian) or the Matriculation Exam in the First Division (or equivalent) if they were Indian. Sons of EIR cmployees and graduates of the school in the railway town of Jamalpur would be given preference.

[103] 'Railway Staff College, Dehra Dun: A Further Step in the Progress of India's Railways', *Indian Railway Gazette*, January 1930, pp. 13-15.

[104] D.V. Reddy, *Inside Story of the Indian Railways: Startling Revelations of a Retired Executive* (Madras: M. Seshachalam, 1975).

On the basis of government reports, then, we can say that most schemes put in place to train Indians focused on instruction in (i) Superior functions in Traffic, (ii) Superior functions in Mechanical Engineering, and (iii) Subordinate functions. In contrast there are virtually no references in this official literature to any schemes to increase opportunities for Indian officers in Civil Engineering (the other major department), or for the specialist posts of bridge, signal and electrical engineer. Only one exception was found, a scheme proposed in 1926-7, under which the Railway Board was to select 17 Indian graduate engineers (9 from British colleges and 8 from Indian colleges) every year for a year's 'practical training on railway construction', but with no guarantee of permanent employment at the end of it. This scheme, proposed during a particular spell of fresh construction, was a one-off development; indeed it is not clear if it materialised or how long it lasted.[105]

The absence of greater discussion on providing practical training for civil engineers is remarkable, given that such training was considered an essential requirement before a graduate engineer could be employed on the railways. (As we saw earlier, although there existed a source of civil engineering graduates in the form of the Indian government engineering colleges, these men found it difficult to obtain any sort of hands-on training on the railways.) In the face of official silence, it is difficult to establish with certainty the reason for this. However, a clue is provided by some of the questions put to the Railway Board in the Legislative Assembly, which were concerned specifically with Indianisation in engineering posts, as opposed to the Superior Services as a whole. A telling example is a question put by Lala Duni Chand in 1926. He asked if it was true that the Railway Board had 'virtually refused to carry out' the Indianisation of higher posts; that Indian graduates, even after training, were deemed unfit for higher appointments; that Indians with qualifications from the Indian engineering colleges were 'invariably refused appointments in the Railway Engineering Service'; and that 'engineers turned out by the Engineering Colleges of the United Kingdom are appointed railway engineers on high salaries while equally qualified and far less expensive Indians are not appointed'. The charges were denied brusquely, but the question served to demonstrate politicians' scepticism about the authorities' commitment to Indianisation—especially with regard to the Civil Engineering department.[106] The Civil Engineering department, or 'Engineering Establishment', was the most prestigious in the railway hierarchy, usually listed before the other railway departments in government employment directories. The officer who rose to Agent (on the company railways) or General Manager (on the state railways) was often a civil engineer or a

[105] *Statement exhibiting moral and material progress*, 1926-7, pp. 173-4.
[106] *Extracts from the Debates in the Indian Legislature on Railway Matters: Delhi Session – January-March 1926* (Calcutta: Government of India Central Publication Branch, 1926), p. 79. APAC: IOR/V/25/720/44.

military engineer.[107] This fact, combined with the attitudes discussed earlier, which viewed Indians as inefficient and their loyalty to the state as questionable, probably made it important, in the eyes of the Railway Board, to limit the pace of Indianisation in the engineering establishment. Put another way, it is likely that greater measures were taken to Indianise the middle and lower levels of the railway bureaucracy than the highest.

Indeed, despite the various steps towards Indianisation in some areas, the highest echelons of the railways' Superior Services were marked by continuity over our period: European dominance was still their most visible feature. There were few Indians in the higher ranks of the railway Engineering departments and their upper management. As late as 1940, there was only one Indian among the Chief Engineers and General Managers on the state railways (L.P. Misra, a Roorkee engineer, General Manager of the Eastern Bengal Railway).[108] By contrast, Indian Chief Engineers appeared earlier in the princely states, whose internal policies were largely independent of the colonial government. For instance, in 1930 the Cutch State Railway appointed as Manager and Engineer-in-Chief S.K. Kothari, an Indian engineer.[109] The Gaekwad's Baroda State Railway had only a handful of engineers listed (all of them Indian) in 1931 and 1932, many of them affiliated to the Institution of Engineers (India).[110] Other features of the railway bureaucracy remained unchanged through the 1920s and '30s. A perusal of the *India Office List*s for various years shows, for the state railways, the continued presence of Royal Engineers throughout this period. It also shows that Indian technical specialists, i.e. bridge, signal and electrical engineers, were few and far between.

Committees formed to discuss points of cooperation between the various railway systems (whose lines were interlinked) were also staffed primarily by British officers. The Indian Railways Conference Association (IRCA) was formed in 1902 'to frame rules and regulations for booking of traffic and interchange of trains between railways'.[111] This body, made up of the top management (most of them engineers) of the various lines, was predominantly European in our period, reflecting the fact that Indians had not yet climbed to the top rungs of the railway hierarchies.[112] There were no Indians among the delegates of the

[107] *India Office List*s, various years.
[108] *India Office List* for 1940; 'Sir Lakshmi Pati Misra' in 'Luminaries', http://www.iitr.ac.in/institute/pages/Heritage+Luminaries.html, accessed 22 July 2011.
[109] See portrait of Kothari and caption in *Indian Railway Gazette*, January 1930, p. 3.
[110] *Thacker's Indian Directory* for 1931 and 1932. On the Institution of Engineers (India), a professional society, see Chapter 3 of this thesis.
[111] 'Indian Railways: Indian Railway Conference Association: History', http://www.indianrailways.gov.in/railwayboard/uploads/directorate/IRCA/index.jsp, accessed 17 July 2012.
[112] Examples of topics discussed include: 'Preparation of a "Code" or standard list of electrical apparatus, fittings and material in regular demand on railways in India' and 'Standardisation of voltages (pressures)

IRCA's 1920 meeting, who included Major-General Sir H.F.E. Freeland, Agent, Bombay Baroda & Central India Railway (presiding); C.D.M. Hindley, Agent of the East Indian Railway; and F.A. Hadow, Agent of the North-Western Railway.[113] Sixteen years later, the IRCA was still a British-dominated body, as indicated by its office-bearers. The President was J.C. Highet, AMICE, Agent of the North-Western Railway, Lahore; the General Secretary B. Lawrence, MICE, Delhi; and the Deputy General Secretary S.S. Stubs, BA Mechanical Science (Cambridge), of Delhi.[114]

Finally, the Railway Board itself exhibited a similar trend. Indians rarely rose to the top positions. The lists of its office-bearers in three sample years (1934, 1937 and 1942) reveal that the offices of Chief Commissioner, Railways, and Director of technical departments like Civil Engineering and Deputy Directors of Mechanical Engineering were held almost without exception by Europeans. The highest post attained by an Indian was Financial Commissioner (Sir Raghavendra Rau and T. S. Sankara Aiyar, the latter an engineer by training).[115]

Conclusions

This chapter has shown that the senior staff of the railways in interwar India formed a technical bureaucracy in which various types of engineer played an important role. Of these 'Superior Service' officers (on state and company railways taken together) nearly 80 per cent were Europeans at the start of the 1920s. In response to demands by increasingly powerful nationalist politicians, the government agreed on a policy of Indianising this cadre, setting itself a dual target: achieving a 50 per cent Indian share in the cadre (within an unspecified time frame), and recruiting fresh officers in the ratio of 3 Indians to every European.

A.C. and D.C. to be adopted in railway workshops for motors, lighting and portable tools'. Indian Railways Conference Association 1928, *Agenda and Proeedings of The Electrical Section: Meeting No. 1* (place and date of publication not given), p. i. British Library shelfmark: W 4026.

[113] Indian Railway Conference Association, *Proceedings of the Conference of Railway Delegates Assembled at Simla, October 1920* (Simla: Government Central Press, 1920). APAC: IOR/V/25/720/42.

[114] 'Directory of Railway Officials', *Indian Railway Gazette*, January 1936, p. iii. APAC: SM 150 (Microfilm), Box: 1936-1937.

[115] Appendix H: 'Officers of the Railway Department (Railway Board) and attached offices, on 31st March 1934', *Report by the Railway Board on Indian Railways for 1933-4*, Vol. I (Delhi: Manager of Publications, 1934), p.114; Appendix H: 'Officers of the Railway Department (Railway Board) and attached offices, on 31st March 1937', *Report by the Railway Board on Indian Railways for 1936-7*, Vol. I (Delhi: Manager of Publications, 1937), pp. 152-3; Appendix A: 'Officers of the Railway Department (Railway Board) and attached offices, on 31st March 1942', *Report by the Railway Board on Indian Railways for 1941-2*, Vol. I (Delhi: Manager of Publications, 1943); p. 36. One P.R. Rau is listed as Financial Commissioner for 1933-4, and is most probably the same person as Sir Raghavendra Rau (Financial Commissioner 1936-7).

However, the actual ratio in which recruitment was carried out in the following decade consistently fell short of this formula of 75 per cent Indians (it was more in the range of 60 to 70 per cent). It was not until the late 1930s that the targeted 50-50 composition of Indians and Europeans was reached. The retrenchment or departure of European officers during the Depression and after the outbreak of World War II was a significant factor in this change in composition, the contribution of which was as important as fresh recruitment of Indian officers.

Further, I have demonstrated that the government's Indianisation strategy varied across railway departments. While new facilities were put in place for the training and recruitment of Indians in the Traffic and Mechanical Engineering departments, and for subordinate posts, the traditionally pre-eminent Civil Engineering Department (and specialist positions such as bridge and signal engineering) saw no fresh measures, and a lower Indian share among those recruited. The most likely explanation for this is that civil engineering was considered the department with the greatest responsibility (most of the top management were drawn from this department), and hence the one for which Indians were least fitted, given the prevailing conceptions of their character and abilities.

In general the government, while making several concessions to the political currents of the time and acceding to Indianisation in principle, considered the railways a vital part of the colonial state, and was careful to avoid changing the character of their senior staff drastically. The railways' important role in internal and external security and their susceptibility to sabotage in case of mass unrest made the presence of 'loyal' (European) engineers on them crucial. There was also a pervasive feeling among influential members of the railway community that the railways must be run like profit-making businesses, and that there was little room for recruiting practices that might lead to a lowering of 'efficiency'— i.e., Indianisation. Thus security concerns, coupled with fears of inefficiency in the running of the service and a negative view of Indians' aptitude and capabilities, made the authorities cautious in undertaking the Indianisation of engineering and other technical jobs in the railways.

CHAPTER 6

Industrial Engineers and Extra-Imperial Influences

The technical experts of the Tata steel works

Introduction

In the interwar period Indian business families (such as the Tatas, Birlas, Walchands and Kirloskars) began to invest heavily in large-scale industry, challenging European-owned firms for the first time.[1] Of these Indian-owned enterprises, the Tata Iron and Steel Company (TISCO) was exceptionally large and successful. TISCO was the first major producer of steel in India, and achieved a near-monopoly in the domestic market. Its success was instrumental in the creation and operation of several ancillary industries that consumed steel.

Economic historians have argued that TISCO was an exceptionally successful case among large-scale industrial enterprises in interwar India, in that it overcame many of the constraints on industrialisation under the colonial government. The growth of most industries, they argue, was limited by factors such as the government's fiscal policy, inadequate protection of Indian industry, lack of domestic demand, scarcity of capital, lack of technological know-how, and the risk-averse behaviour of India-based industrialists.[2] TISCO's success is attributed variously to the vision and foresight of the company's founders, the management's good relations with the colonial government and its resultant obtaining of economic protection, capital investments made after World War I, and effective sales strategies.[3] Yet the literature does not pay sufficient attention to another very important factor: TISCO's strategies in recruiting and training its engineering personnel. Similarly, the historiography of science and technology tells us little about the experience of scientists and engineers working in large-scale

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[1] Dietmar Rothermund, *An Economic History of India: From Pre-Colonial Times to 1991* (2nd edition, London: Routledge, 1993), p. 92; Rajat K. Ray, *Industrialization in India: Growth and Conflict in the Private Corporate Sector 1914-47* (New Delhi: Oxford University Press, 1982 [1979]), p. 5; B.R.Tomlinson, *The Economy of Modern India, 1860-1970* (Cambridge: Cambridge University Press, 1996 [1993]) (*The New Cambridge History of India*, III, 3), p. 143.

[2] Rothermund, *An Economic History of India*, pp. 61-5; Ray, *Industrialization in India*, pp. 3, 81, and Ch. 4; A.K. Bagchi's argument as described in Tirthankar Roy, *The Economic History of India* 1857-1947, second edition (New Delhi: Oxford University Press, 2006), p. 263. Although the literature emphasises the limits of industrial growth, it does show that there was an appreciable growth in large-scale industry over the interwar period (see Chapter 2).

[3] See Ray, *Industrialization in India*, pp. 74-93; Chikayoshi Nomura, 'Selling steel in the 1920s: TISCO in a period of transition', *Indian Economic and Social History Review*, 48, 1 (2011), pp. 83-116.

industrial firms, focusing as it does on intellectuals' debates on the role of science-based industry in the future nation.[4] An exception is Daniel Headrick's brief account of the creation of TISCO and the Indianisation of its technical personnel.[5] Headrick uses his account to illustrate his larger argument that 'technology transfer' in colonial India (the introduction of particular techologies, the required machinery, and the associated expertise and technical culture from the metropolis into the colony) was of a limited nature.[6] This chapter, by contrast, takes the industrial experts themselves—their backgrounds, skills and characteristics—as its primary subject.

In addition to published memoirs and company newsletters, this chapter makes extensive use of official correspondence, memoranda and records in the Tata Steel Archives to identify several technical experts of TISCO in the interwar period and study them in detail. It shows that while the role of British engineers—and of technical instructors schooled in the university and industries of Sheffield—was significant, the technical work of TISCO was not led or directed by British expertise (unlike in the case of the public works and railways). Rather, Americans and American-trained Indians were the most important of the multi-national group of experts that ran the technical operations of this pre-eminent industrial enterprise. The existence of foreign experts is recognised in the existing literature. However, their training, the nature of their expertise, and the culture of engineering they brought to TISCO have not been studied before. Here, I will show that these superintendents and managers, many of whom were schooled in the steel works of their home countries, shaped a working culture that laid great store by practical experience, physical fitness and presence of mind on the shop floor.

These findings will be linked to the ongoing analysis of Indianisation. Within TISCO, this development was systematised in the inter-war period through the Tatas' Jamshedpur Technical Institute (JTI, est. 1921), a pioneering step in industrial education in the country. Several accounts of TISCO mention the Institute and its role in Indianisation,[7] but none explores at any length the Institute's functioning (such as the staff, curriculum, funding, selection of students, and the educational context in which it was established and operated). Focusing on

[4] E.g.: Shiv Visvanathan, *Organizing for Science: The Making of an Industrial Research Laboratory* (Delhi: Oxford University Press, 1985); Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton: Princeton University Press, 1999), Chapter 6; Pratik Chakrabarti, *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (Delhi: Permanent Black, 2004).
[5] Daniel Headrick, *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York and Oxford: Oxford University Press, 1988), pp. 285-94 and pp. 371-4.
[6] See *ibid*., p. 9 for Headrick's definition of technology transfer.
[7] E.g. Ray, *Industrialization in India*, p. 91; Headrick, *Tentacles of Progress*, p. 373; and Hiruyoki Oba and Hrushikesh Panda (eds.), *Industrial Development and Technology Absorption in the Indian Steel Industry: Study of TISCO with Reference to Yawata — A Steel Plant of Nippon Steel Corporation in Japan* (Mumbai: Allied Publishers, 2005), Chapter 6.

these aspects, this chapter argues, as Chapters 4 and 5 did for public works and the railways, that a level of continuity in the work culture was maintained while pursuing Indianisation. Indians trained in the Institute were expected to combine a mastery of the theory of steel manufacture with intensive practical learning in the TISCO works itself. Physical fitness and industriousness remained important, being key parameters in the selection of students for the Institute and thereafter for jobs in the works. This remained true even when the Institute's main programme evolved into a more specialised one designed for graduates in metallurgy and engineering.

Despite these similarities, the pattern of Indianisation within TISCO was markedly different from that in government technical services. In this private company owned entirely by Indian capital, Indianisation was mainly an internally driven process. Political demands for Indianisation played a minor and indirect role here, whereas in the case of public works and railways, public opinion and the continuous pressure applied by Indian legislators were crucial drivers of Indianisation. Further, whereas most Indian technical experts who entered government services were educated at the state's engineering colleges (which had the patronage of PWD appointments) or trained at government-run railway workshops and technical schools, the role of the colonial education system in the Indianisation of TISCO was small—for this the company relied on its own institute, the JTI, and on Indians trained abroad.

Multi-national experts and the culture of steel-making

Although the Tata Iron and Steel Company was formally registered in 1907, the first steps towards its establishment had already been taken at the turn of the twentieth century by Jamsetji Nusserwanji Tata, a successful owner of textile mills in Bombay and Nagpur. According to his biographer, J.N. Tata had long nurtured the ambition of setting up an iron and steel works in India, where no producer of steel existed. By the end of the nineteenth century, preliminary reports had been published indicating iron and coal deposits in India, and in 1899 the government relaxed its restrictions on mining by private agencies. Tata then secured prospecting licences for some districts in central India and had his representatives explore the area for ore.[8]

From this stage through to the early years of the plant's functioning, the technical work of the company was carried out by an international group of experts under the direction of Americans. This expertise was embodied in several types of personnel: those who carried out

[8] R.M. Lala, *For the Love of India: The Life and Times of Jamsetji Tata* (New Delhi: Penguin/Portfolio, 2006 [2004]), Chapter 18. Although a company called the Bengal Iron Works was already functioning, it had so far manufactured only iron, not steel. Headrick, *Tentacles of Progress*, pp. 282-4.

the initial prospecting; the construction engineers who built the plant itself; the technical superintendents and managers who ran the various production departments; and the experts in charge of the rest of the plant and the township in which it was located.

The role of American construction engineers began soon after Tata had acquired his prospecting licenses. In the early 1900s, he travelled to the USA in search of expert assistance. In doing this he not only acknowledged the contemporary success of America's steel industry, but also took the then unusual step of venturing beyond the British Empire. While in America, Jamsetji 'studied coking processes at Birmingham, Alabama, visited the world's largest ore market at Cleveland, and in Pittsburgh met the foremost metallurgical consultant, Julian Kennedy.' Kennedy agreed to build a works in India provided a detailed survey of materials was conducted. He recommended for the survey the New York consulting engineer C.P. Perin.[9]

The grandson of an engineer, Charles Page Perin (b. 1861) had an A.B. from Harvard College, and had also studied at the Écoles des Mines in Paris. Working his way up as an engineer in the Carnegie Steel Company and in steel plants in Alabama, Kentucky and Tennessee, Perin set up as a consulting engineer in 1900. He was credited with the building of coke plants, whole industrial towns in Virginia, and an electrolytic iron works at the Niagara Falls. In the course of his career he worked in various countries including China, Spain, South Africa and Russia.[10] It was in 1902 that Jamsetji met him upon Kennedy's suggestion. Perin accepted the role of chief consulting engineer to Tata's putative steel works (his firm continued to be consulting engineers to the Tatas' steel company until 1936).[11]

Over the next few years Perin's partner C.M. Weld successfully led explorations in North-Central India culminating in the selection of a site for the steel plant: the village of Sakchi, less than 200 miles west of Calcutta.[12] Although Jamsetji died in 1904,[13] the enterprise continued under his son Dorabji. In 1907 the Tata Iron and Steel Company was registered, a sum of Rs. 23.2 million having been raised from investors in India. Tata and Sons (later Tata

[9] R.M. Lala, *The Creation of Wealth: The Tata Story*, paperback edition (Bombay: IBH, 1981), Chapters I and II. The quote is from p. 20.
[10] 'Dr. Charles Perin, Engineer, 75, Dies', *New York Times*, 17 February 1937, p. 21.
[11] Lala, *Creation of Wealth*, p. 20; R.M. Lala, *The Romance of Tata Steel* (New Delhi: Penguin/Viking, 2007), p. 62. For the date of Jamsetji's trip and the duration of Perin's association with the Tatas, see ' "C.P." ' in *TISCO Review*, April 1937, p. 255. Several issues of *TISCO Review* and *TISCO News* were consulted at the Tata Steel Archives, Jamshedpur, and a few at the Tata Central Archives, Pune.
[12] Lala, *Creation of Wealth*, pp. 20-3; C. Minot Weld, 'The Beginnings of the Tata Iron & Steel Company', *TISCO Review*, November 1933, pp. 2-8. The Tatas had been led to the Gorumaishini deposits by P.N. Bose, formerly of the Geological Survey of India and at this time state geologist of Mayurbhanj, the princely state in which the deposits were located. Jogesh Chandra Bagal, *Pramatha Nath Bose* (New Delhi: Sushama Sen on behalf of P.N. Bose Centenary Committee, 1955), Chapter VIII.
[13] Lala, *Romance of Tata Steel*, p. 13.

Sons) of Bombay held a share of 11 per cent in the new company and were appointed TISCO's managing agents.[14]

The American engineers of Julian Kennedy's and Perin's firms led the building of the new plant at Sakchi (later renamed Jamshedpur after Jamsetji Tata). Axel Sahlin, from Julian Kennedy, Sahlin and Company, arrived in February 1908. He was accompanied by W.O. Renkin (c.1875-1943), who was appointed resident construction engineer. Renkin was a Pittsburgh native who, in his lifetime, held high positions in various companies such as the Quigley Fuel Company (New York), the A.M. Byers Company (Pittsburgh), and the Coke Dry Quenching Equipment Corporation.[15] C.M. Weld, who had led the prospecting efforts, stayed on to supervise the work until the arrival of the first in a long line of American General Managers, R.G. Wells, in January 1909.[16] Wells, an expert in the building of iron works, had worked previously in Mariopol in imperial Russia and with the Dominion Iron and Steel Company in Sydney, Nova Scotia (Canada).[17]

A number of British and Indian engineers worked with these Americans. In 1908-9 a Scottish mining engineer, McNeil, was drafted in to assist with the mining of ore, while an English engineer, B.B. Willcox, was engaged to assist C.M. Weld until his departure from Sakchi. Srinivasa Rao, an Indian graduate of the Mysore State Geological School, had, along with Weld, Dorabji Tata and Shapurji Saklatvala (Dorabji's cousin), been a part of the early prospecting expeditions; after his premature death from cholera, another Indian, Vyas Rao, took over the prospecting and geological work. Weld records that the site chosen at Sakchi was surveyed by 'a corps of native engineers' under Willcox.[18] K.R. Godbole, an Indian who had previously worked in the Public Works Department, was made civil engineer responsible for amenities in the township that would be built in Sakchi.[19]

Unsurprisingly, this mixed group of experts had diverse styles of functioning. A contemporary observer, Mrs. B.J.M. Cursetjee, referred to '[w]atchful Weld', '[v]igorous,

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[14] Lala, *Creation of Wealth*, pp. 21-4; Weld, 'Beginnings'; Verrier Elwin, *The Story of Tata Steel* ([Bombay], n.p.: [1958]) (British Library Shelfmark W 3092), p. 37; Lala, *Romance of Tata Steel*, p. 17, footnote 2; John L. Keenan [with Lenore Sorsby], *A Steel Man in India* (New York: Duell, Sloan and Pearce, 1943), p. 34. Rothermund, *Economic History of India*, p. 61, argues that investing in TISCO afforded wealthy Indians a means of 'showing their patriotism' in a discreet way. These rich Indians included rulers of the princely states, who were under the ultimate authority of the colonial government.

[15] Weld, 'The Beginnings of the Tata Iron & Steel Company', p. 5; 'The Late Mr. W.O. Renkin', obituary appearing in *TISCO Review*, December 1943, p. 242. Sakchi was renamed at the end of World War I. Lala, *Romance of Tata Steel*, p. 29.

[16] Weld, 'The Beginnings of the Tata Iron & Steel Company', p. 8.

[17] F.R. Harris [with Lovat Fraser], *Jamsetji Nusserwanji Tata: A chronicle of his life*, 2nd edn (Bombay: Blackie & Son, 1958), p. 203.

[18] Weld, 'The Beginnings of the Tata Iron & Steel Company' (the quoted words are on p. 5); Lala, *Creation of Wealth*, Chapter II.

[19] See Lala, *Romance of Tata Steel*, p. 20.

forceful, impressive Perin', and 'tall, broad-shouldered, active' Sahlin, and indicated that there was some friction: 'What a struggle between blustering, bullying Renkin who wanted work pushed at any cost and patient, white-turbaned, methodical, Godbole.'[20] Axel Sahlin found Godbole something of a curiosity, writing: 'the Tata Co. have a Civil Engineer, Mr. Codbole [sic], who is a Brahmin of high caste. I do not know how many washings it will take him to get clean after he has associated with us an entire day.'[21] These minor clashes notwithstanding, work progressed, and the plant soon became operational, producing its first steel in 1912. The plant was built with a capacity of 72,000 tons of finished steel per year. The machinery installed, which had been purchased in America and Germany, comprised two blast furnaces (capacity 175 tons per day), four Siemens-Martins open hearth furnaces, a blooming mill, a rail and beam mill, two bar mills, and 180 Coppee coke ovens.[22]

Foreign consultants and technical advisers continued to be important after the inauguration of the plant. When problems were faced with the open hearth furnaces just before World War I, Charles Perin came to Jamshedpur along with Ralph Watson, an open-hearth expert whose services were lent to him by the Carnegie Steel Company, and the furnaces were set right.[23] Perin was also a critical figure during the Greater Extensions programme, an expansion of the plant that began in 1916, aiming to raise the works' output by a factor of five.[24] In his New York office, Perin took on two new partners, and employed 300 engineers and draftsmen, sending 700,000 tracings and 3 million blueprints to India in the years 1917-20.[25] In the interwar years, the company employed as its Technical Advisor a British expert named Richard Mather.[26] Born in 1886, he had been educated at Sheffield University, worked at the Ormsby Iron Works in Middlesborough, done metallurgical research for the British War Office in Woolwich, and been Metallurgical Inspector to the Government of India before he joined the Tatas.[27]

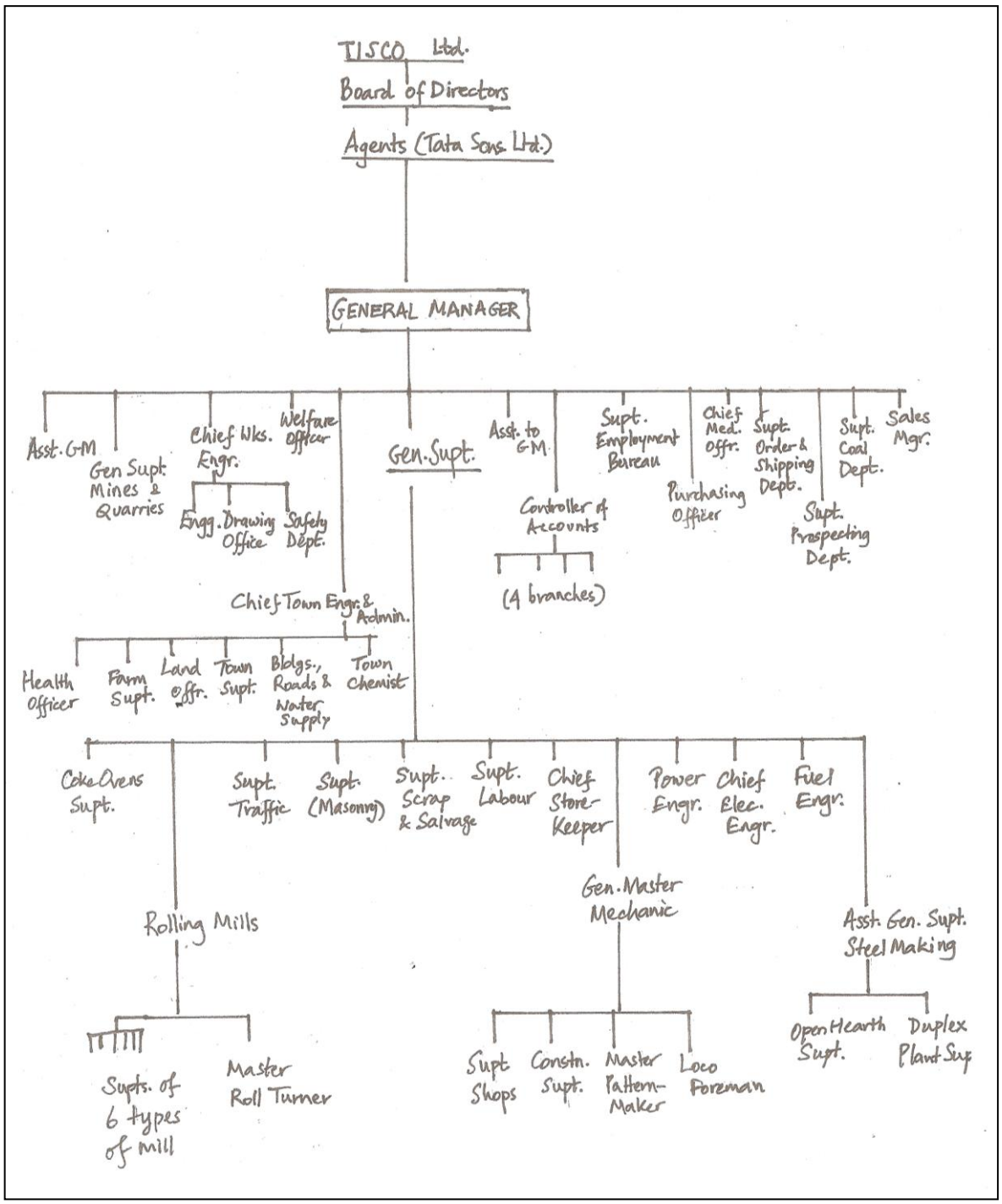
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[20] B.J.M. Cursetjee, quoted in R.M. Lala, *Romance of Tata Steel*, p. 20.
[21] Axel Sahlin, 'Personal Impressions of India: Written for his friends by Axel Sahlin: January 15th to April 21st, 1908', p. 24. Booklet consulted at the Tata Steel Archives, Jamshedpur (hereinafter TSA).
[22] 'The Tata Iron and Steel Company Ltd. 1907 to 1934', *TISCO Review*, Nov 1934, p. 718ff, here p. 718 and p. 722; Headrick, *Tentacles of Progress*, p. 291.
[23] Keenan, *Steel Man*, pp. 42-3.
[24] Lala, *Romance of Tata Steel*, pp. 36-37.
[25] Lala, *Romance of Tata Steel*, pp. 37-9; Keenan, *Steel Man*, p. 68.
[26] Mather's designation as given in a letter from TISCO (signature illegible) to S.R. Dongerkeri, Registrar of Bombay University, 30 November 1937, Folder: D-51, Box 51: Private Papers, R. Mather, TSA.
[27] Cutting of entry on Mather in *Illustrated All-India Trade Directory and Who's Who*, 1942. Enclosed with letter from Barque and Company, Lahore (publishers of the *Who's Who*), 20 January 1943, inviting him to make changes if required for the 1943 edition. Folder: D-51, Box 51: Private Papers, R. Mather, TSA.

Meanwhile, the second major category of technical experts arrived in Sakchi around 1910. These were the superintendents and managers who would run the various production and support departments. From Figure 6.1 below, which gives an idea of the organisation structure of the works in the interwar period, we may estimate that they numbered in the range of 20 to 30. Initially most of them were foreigners. These experts, in addition to skilled workers from various foreign countries, made up a foreign contingent of about 175 in an overall workforce of around 2,000.[28]

[28] This was in addition to several thousand unskilled labourers recruited locally. Harris [with Fraser], *Jamsetji Nusserwanji Tata*, p. 202; Lala, *Romance of Tata Steel*, p. 27.

Figure 6.1: *Organisation structure of TISCO, interwar period* [29]



[29] Abridged from undated diagram titled: 'A Chart showing the Organisation of the Staff, both administrative and departmental with the monthly Expenditure of each Dept.', courtesy Tata Steel Archives, Jamshedpur. That the chart refers to the interwar period is inferred based on the expenditure figures marked on the original chart. For example, expenditure under General Manager (all or most of which would have been his salary), is marked Rs. 7,500—which is broadly commensurate with the average salary figures in Table 6.1 below (those figures include bonuses).

All the foreigners, irrespective of designation, were employed on renewable contracts and referred to as 'covenanted' staff. The usage of the term was similar, but not identical, to its use in government services such as the railways: in TISCO 'covenanted' referred not to a particular officer grade but to the terms of employment, thus covering both technical experts (officers) and skilled workers (operators). The term was not used for Indians.[30] However, like their counterparts in the government services, TISCO's covenanted employees were paid high salaries (in particular, they earned more than the few Indians who reached the same positions, as shown later in this chapter) and granted other benefits such as company housing. Bachelors were housed together in company-built bungalows or lodged at a local hotel, while those who were married had independent houses.[31] A race course was set up for the entertainment especially of the imported staff, whose sporting adventures were made possible by their high salaries.[32]

Like the construction engineers before them, the covenanted employees were drawn from several countries. During his extensive travels many years earlier, Jamsetji Tata had formed views on the strengths of various nations in particular aspects of steel-making. He had communicated these views to his son, suggesting that workers for the plant's departments be sourced according to these strengths.[33] Visiting the works in 1911, the journalist Lovat Fraser reported a division of labour that followed this advice:

> Mr [R.G.] Wells [of the USA] was General Manager, and his chief assistants in the management, as well as the Blast Furnace Superintendent and his staff, were all Americans. The crew of the steel works [open hearth furnaces] and their superintendent were Germans. The superintendent and crew of the rolling-mills were English. The clerical staff was chiefly composed of Bengalis and Parsees, and there were a few extremely efficient Parsees in the various mechanical departments. There were a certain number of Austrians, Italians, and Swiss, while Chinese were working as carpenters and in the pattern-shops.[34]

It appears that the superintendents of each department brought along workers from their respective countries to form their crews. Thus the blast furnace department had a group of steel operators from eastern Pennsylvania, probably schooled in the mills of Pittsburgh, while the

[30] A footnote at the start of the next section demonstrates in detail that 'covenanted' referred only to foreigners. The usage of 'covenanted' in the railways to mean the officer grade is mentioned in Chapter 5.
[31] Keenan, *Steel Man*, p. 38; Lillian Ashby (with Roger Whately), *My India: Recollections of Fifty Years* (Boston: Little, Brown and Company, 1937), pp. 359-60. Lillian Ashby's husband Robert was a high-ranking police officer in Jamshedpur in the interwar period.
[32] Ashby, *My India*, p. 298; Keenan, *Steel Man*, Chapter 3.
[33] Keenan, *Steel Man*, p. 38; also mentioned in Headrick, *Tentacles of Progress*, p. 371, citing Keenan.
[34] Harris [with Fraser], *Jamsetji Nusserwanji Tata*, p. 202.

German head of the open hearth department (according to the possibly biased testimony of an American superintendent) even selected for an important position 'a man who had had no steel-making experience at all; he had, however, been an officer in the Kaiser's own regiment.'[35]

As was already evident to Lovat Fraser in 1911, the plant at its highest levels was managed almost exclusively by American experts schooled in the steel industry of their home country. In its first three decades, TISCO's General Managers were engineers or steel experts from the USA. The General Manager was the most important functionary in Jamshedpur, having charge of the entire operation of the works and the township. As an experienced construction engineer, R.G. Wells, the first General Manager, was a suitable choice for the early years when the works were being built and inaugurated. His successor, T.W. Tutwiler (General Manager 1916-25), was a veteran of the steel works in Gary, Indiana.[36] John L. Keenan (General Manager 1930-37) was also a former Gary employee. He had worked there under Tutwiler, who recruited him to TISCO in 1913 as a foreman in the blast furnace department. The Irish-American Keenan was born in Roxbury, Massachusetts in 1889. He studied mainly Classics and economics at Boston Latin School and Yale University before he was trained in steel-making on the job, at the Wharton Steel Company of New Jersey and later at the Gary Steel Company. Keenan rose steadily in TISCO, going through various departments: he became in succession Assistant Superintendent (open hearth furnace), Assistant Superintendent (duplex plant), Superintendent (blast furnace) and General Superintendent of the works (in 1926, four years before he became General Manager).[37]

These high-level executives established a brisk, no-nonsense culture in the works. Tutwiler was known for his brusque demeanour. He is reported to have said to the Viceroy Lord Chelmsford (when asked politely if he was the General Manager), 'You're Goddam right'—an answer which nearly precipitated a diplomatic crisis.[38] Tutwiler believed that 'a steel works was no place for weaklings . . . stern discipline, punctuality and hard work were essential to success . . . the right to hire and fire and lay down the law was a God given right [of the managers].'[39] Keenan comes across in his memoir as a tough-talking but fair-minded man who preferred a down-to-earth attitude to ostentation. He disapproved of the behaviour of a group of college-

[35] Keenan, *Steel Man*, pp. 38-40. The quote is from p. 40.
[36] Lala, *Romance of Tata Steel*, p. 65; for years of General Managership see entry on Tutwiler in 'Vanguards', http://www.tatasteel100.com/people/vanguards.asp (accessed 1 July 2012).
[37] 'John L. Keenan, 54, Steel Authority', obituary in *New York Times*, 8 Jan 1944, p. 13; 'The Late Mr. J.L. Keenan', obituary appearing in *TISCO Review*, March 1944, pp. 20-1; Keenan, *Steel Man*, pp. 1-3. Keenan was an astute observer, and his 1943 memoir, *A Steel Man in India* (cited above) is an important source on the environment in the TISCO works in the interwar years.
[38] Lala, *Romance of Tata Steel*, p. 65.
[39] J.R.D. Tata, a later Chairman of Tata Sons, commenting in 1956 on Tutwiler's approach, as quoted in Oba and Panda (eds.), *Industrial Development and Technology Absorption*, p. 70.

educated construction engineers from America who camped in Jamshedpur when the works were being extended. He noted that they

> didn't mix with the American and British steel operators. The old-timers … danced the waltz, two-step and even the Lancers, the newcomers danced the fox-trot, the Lame Duck, and the tango … They disdained our whiskeys and sodas, insisting on cocktails and other poisonous concoctions. The old crowd talked of horses and men; the youngsters of golf, dancing and women; they seemed to regard their stay in India as part of a world pleasure tour.[40]

The experts at the lower managerial levels came from Europe as well as America, and had varied educational backgrounds: some were university-educated, but many were practically trained.[41] An example is F.K. Bennett (1860-1932), who was born in Sheffield and went to the USA at age 10. Starting as a water boy, he was trained as a roller in the Pennsylvania Steel Company, eventually becoming Superintendent of Rolling Mills there before joining TISCO in 1914. An expert roller, he was Mills Consultant to the company for five years until his retirement in 1928.[42] European experts included Ernest Blaser, a Swiss engineer in charge of the boiler plants,[43] and E.R. Nicholson of Northumberland, who joined the company in 1918 as Master Pattern-Maker, later becoming also Assistant Foundry Superintendent.[44] R.M. Prowse, who was briefly Electrical Engineer at TISCO in the late 1930s, had a background spanning three continents. He was born in Devon, educated in South Africa, and further trained in England and the USA before joining the Tatas.[45]

Foreign-trained Indians

Although the plant relied heavily on foreign experts in the early years, there is evidence to show that this was due more to practical concerns than to any prejudice against Indian engineers. As early as 1909, Axel Sahlin, whose firm built the plant, had mooted the idea of sending Indians to Europe or America for training in steel manufacture. However, the Board of Directors had reservations about the costs involved. An alternative was suggested by Bezonji Dadabhoy, who was associated with an older Tata concern, the Empress Mills (textiles) of Nagpur. Bezonji

[40] Keenan, *Steel Man*, p. 82.
[41] '[T]he European department heads … Many of them had little or no higher education. They had learned what they knew by doing it.' Keenan, *Steel Man*, p. 137.
[42] *TISCO Review*, December 1932, p. 23.
[43] Keenan, *Steel Man*, pp. 44-6.
[44] 'Mr. E.R. Nicholson', *TISCO Review*, December 1933, p. 20.
[45] 'Obituary', *TISCO Review*, April 1940, p. 291.

recalled that at his company a few Englishmen had initially been in charge, and had successfully trained Indians to take over from them. He continued:

> I do not think it would help your Company, though it may help India generally to send out young Indians to the U.S. to study and work in the Steel Works there. I would suggest apprentices being taken up and trained under American Experts, who may be brought out for starting and working the Steel Plant at Kalimati [the name of the railway station near Sakchi].

It was the question of costs that ultimately decided the issue. R.G. Wells, the General Manager at Sakchi, reported that '[u]pon completion of our recent estimate of capital expenditure we came to the conclusion that the matter of sending Apprentices [abroad] … should be entirely abandoned.' It might be a good idea in ideal circumstances, 'but the Company certainly has no money to spend for such purposes.'[46]

Nevertheless, a few years later, TISCO was able to recruit from the growing band of Indian engineers and metallurgists who had begun to travel abroad on their own initiative for training. These students had turned to foreign countries as the existing education system in India was weighted too far in favour of 'literary and philosophic studies to the neglect of those of a more practical character.' Some of them received technical scholarships instituted by the colonial government, by private societies or by princely states, while others supported themselves by working alongside their studies.[47]

The USA was a particularly attractive destination. This appears to have been so because it was easier to get industrial apprenticeships (as a supplement to formal education in the universities) in America than in Europe. The Hindusthan Association of America—a body set up by Indians in New York to guide prospective Indian students in the USA—claimed that 'America offers the best of opportunities to foreign students.' Foreigners were free to join American universities as well as the 'annual apprenticeship courses' in American factories. Such practical training was an essential part of a 'scientific and industrial education', and it was

[46] Various letters in GM's correspondence, April 1909. Participants include General Manager (R.G. Wells), Agents (Tata Sons), and Bezonji Dadabhoy. See sheets 13-26 in Box: General Manager's Correspondence, 1909, TSA. On Bezonji Dadabhoy (Mehta), see 'Sir Bezonji Mehta (1840-1927)', http://www.tatacentralarchives.com/history/biographies/02%20bezonjimehta.htm (accessed 1 July 2012).

[47] Indian Industrial Commission, 1916-18, *Report* (Calcutta: Superintendent Government Printing, 1918), Chapter X, 'Industrial and Technical Education' (quoted text from p. 104); Bagal, *Pramatha Nath Bose*, pp. 91-2; Ross Bassett, 'MIT-Trained Swadeshis: MIT and Indian Nationalism, 1880–1947', *Osiris* Vol. 24 (2009), pp. 212-230. The first of these sources is hereinafter cited as *IIC Report*.

only in America that foreign students could obtain such training 'without [being charged] any compensation or premium whatsoever.'[48]

Many such USA-trained Indian experts joined TISCO starting in the 1910s (in addition to some Indians who had been trained in Germany or England). A.C. Bose, who had graduated from the Carnegie Institute of Technology in Pittsburgh, joined the company as a chemical engineer, and eventually became chief chemist in place of an American. D.C. Gupta, a Bachelor of Science from Harvard, joined the open hearth steel department as third furnace hand around the time of the Great War. He later transferred to the coke-oven department, and in two years became its Superintendent. After eight further years in the department, during which the Welsh foremen gave way to Indians, Gupta left to take up the post of Director of Industries for Bihar and Orissa (which he held from 1926 to 1933).[49]

An incident involving Gupta illustrates the importance placed by the management on employees' physical toughness. In his days as an operator in the open hearth department, Gupta earned Tutwiler's unspoken admiration for an act of physical bravado. On being 'insulted by a big Yorkshire foreman' in his days as an operator in the open hearth department, Gupta had

> said calmly to the man that he had been too long in America to take reflections on his parentage without a fight. The foreman made a pass at him. He dodged and landed a haymaker on the foreman's jaw, putting him out for the count.[50]

In contrast, John Keenan recalled the case of a Bengali, a talented mathematician, whom TISCO had intially rejected 'because he looked ill'. But the company hired him as a coke-oven researcher after he had obtained a degree and two years' industrial experience in Germany. In a few months the new recruit was taken seriously ill and died, apparently unable to take the physical strain. Keenan felt that the management had recruited the unfortunate man 'against their own better judgement.'[51]

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[48] The Hindusthan Association of America [New York City], *Education in the United States of America: For the Guidance of the Prospective Students from India to the United States, Bulletin No. 1, 2nd and revised edn*. (New York City: n.p., 1920), pp. 2-3. British Library Shelfmark: General Reference Collection 8385.a.14.
[49] Keenan, *Steel Man*, pp. 134-5; entry on D.C. Gupta in Record of Services, *India Office List* for 1940.
[50] Keenan, *Steel Man*, p. 134.
[51] *Ibid.*, p. 137.

In one case, that of J.J. (later Sir Jehangir) Ghandy, the company itself appears to have arranged or supported an Indian's studies abroad.[52] Ghandy (1896-1972) was born and educated in Bombay, completing his B.A. honours (physics and chemistry) at St. Xavier's College in 1916 and his B.Sc. honours in chemistry at Wilson's College the following year. He then underwent a spell of practical training at the TISCO works in Jamshedpur before proceeding to the USA, where he studied Business Administration at Columbia University and Metallurgical and Steel Works Engineering at the Carnegie Institute of Technology (Pittsburgh). He returned to India and TISCO in 1921, this time as Metallurgical Engineer in the mill departments. He became the first Indian General Manager in 1938 and later one of the most important TISCO executives in post-Independence India.[53]

Some foreign-trained Indians were recruited in later decades too. C.S.N. Raju, who joined the company as Assistant Power Engineer in 1934, was a graduate of Madras University and an M.S. in Mechanical Engineering from the Massachusetts Institute of Technology. He had worked in America for two years and been Inspector of Steam Boilers, Madras Government for four years before joining TISCO.[54] S.K. Nanavati (c. 1907-1986), who joined the company in 1932, was British-trained. Nanavati did his B.Sc. at the Royal Institute of Science, Bombay, then took the degrees of B.Met (Hons.) and M.Met at Sheffield, followed by that of Doctor Ingenieur (Metallurgiste) from the University of Brussels in 1932. Nanavati went on to become TISCO's General Manager (1961) and its first Managing Director (1970).[55]

The company's management took its time over applications from Indians studying or working abroad, but it also exhibited a degree of flexibility when it felt that a candidate was promising. This is well illustrated by the sequence of events leading up to the appointment of P.N. Mathur, who became one of the most prominent experts in the TISCO works in the 1930s. (Joining the company in 1927, he became Superintendent of the open hearth plant in 1931 and Superintendent of the duplex plant some months before his death from pneumonia in 1940.)

Born in Lahore, Prem Narain Mathur (1892-1940) had dropped out of medical college and made his way to the USA c. 1913. There he got himself into the Ford Motor Company at Detroit, completed a correspondence course in Metallography, and took practical classes in the

[52] Both Lala, *Romance of Steel*, p. 69 and Headrick, *Tentacles of Progress*, p. 373, write that Ghandy was 'sent' to America, whereas the other source on him, an obituary appearing in TISCO's newsletter (cited below), is ambiguous on whether Ghandy went to the USA on his own or was sponsored by the company.
[53] 'Sir Jehangir Passes Away: End of an Era', *TISCO News*, May 1972, p. 2, p. 8 and pp. 14-17; Lala, *Romance of Tata Steel*, pp. 68-9.
[54] *TISCO Review*, June 1935, p. 488.
[55] 'Veteran Steelman [sic] Passes Away: Shavak Kaikhushru Nanavati', *TISCO News*, Jul-Aug 1986, p. 23.

YMCA night school. He was placed in Ford's research laboratory, and over the following years made a name for himself as an expert metallurgist.[56]

A little more than a decade after he had first arrived in America, Mathur decided to move back to India. He began corresponding with the Tatas in October 1924, writing first to Dorabji Tata and then several times to John Peterson, Director of TISCO, applying for a job. In March 1925, favourably impressed by Mathur's credentials, Peterson suggested to T.W. Tutwiler (the outgoing General Manager, who was returning to America) that he should meet Mathur in America and report on him. Meanwhile Mathur was asked to specify his terms, and to furnish details of his personal background. He insisted that pay was not an important criterion, but when pressed, quoted a figure of Rs. 1,500 per month. Tutwiler gave Mathur a glowing report after meeting him in September 1925 (he particularly approved of the fact that Mathur seemed 'like he would be willing to take off his coat [and] jump in'). However C.A. Alexander, the new General Manager, felt that the company might not be able to afford Mathur's asking salary. Thereafter the matter appears to have stalled, despite a further query from Mathur. In January the following year Mathur, now working as Assistant Superintendent in the open hearth department at Ford, wrote to Peterson again. 'What I stand in need of', he wrote, 'is a chance in India. If shown this favour I would be able to work out my destiny as wellin [sic] India as I did in America.' Finally, some months later, the Board of Directors empowered the General Manger to offer Mathur up to Rs. 1,750 per month. In due course he was appointed at Rs. 1,500, and began work at Jamshedpur in late 1927.[57]

The Jamshedpur Technical Institute: Indianising the TISCO works

Although Indians were already being recruited in the 1910s, TISCO soon felt it necessary to systematise the process. During and especially after World War I, the company decided to take into its own hands the training of Indians for supervisory and managerial positions. A number of factors made this a priority.

[56] Capt. B. Dayal, 'Prem Narain Mathur (An Appreciation)', *TISCO Review*, May 1940, pp. 390-2. That Mathur enjoyed a strong reputation as a metallurgist is apparent from the many character references he furnished to TISCO. See the correspondence in Mathur's papers, cited below.

[57] Several letters and a note 'For Favour of Minutes' (date 13 December 1927, title 'SUMMARY – Appointment of Mr. Prem Narain Mathur'), Folder: 'P.N. Mathur, Appointment at Jamshedpur', Box No. 69: 'Private Papers: P.N. Mathur', TSA. The quotes are from the following letters: Tutwiler to Peterson, 20 September 1925; and P.N. Mathur to John Peterson, 20 January 1927.

First, there was a pressing need to reduce costs. The covenanted (i.e. foreign)[58] employees in the works were paid hefty salaries and production-based bonuses. Table 6.1 shows that their average annual pay (including bonuses) was many times that of the Indian uncovenanted staff. It must be noted that this is not a like-for-like comparison (the uncovenanted category included several levels of staff from skilled to unskilled labour, whereas the covenanted staff comprised members of the operating crews, supervisors, and managers). Nevertheless, the comparison shows that covenanted staff were an expensive resource. Further, their numbers dipped between 1912-13 and 1921-22, even as their average income quadrupled, indicating that while foreign workers could be replaced, the expensive managers and experts were still indispensable.[59] There were other overheads. The foreigners were also provided with benefits such as housing and passages from and to their home country;[60] and replacements had to be found for the German open hearth team, whose members were interned in Ahmednagar as enemy aliens when World War I broke out. Furthermore, the company was supplying the Government in excess of 20,000 tons of steel rails per year (at reduced prices) as railroads were built in the battlefields of Mesopotamia, and efficient production was the order of the day.[61] It was apparent that savings could be made if it were possible to find Indians who could attain the higher positions currently occupied by covenanted staff; when an Indian did so, he would be paid a maximum of two-thirds the salary drawn by a foreigner at the same level. This distinction

[58] It is apparent from the use of the term in most sources that only foreign experts were referred to as 'covenanted' employees. Two instances will serve to confirm this:

i) A list of employees presented by the company to the Indian Tariff Board, which shows zero covenanted employees in the coke oven department for 1923-4 and 1924-5, around which time, according to John Keenan, that department was 'completely Indianized'. In other words, the Indians who replaced the foreign workers on the coke ovens, despite doing the same work, were not classified as covenanted. Enclosure VI, Indian Tariff Board, *Evidence recorded during enquiry regarding the grant of supplementary protection to the steel industry* (Calcutta: Government of India Central Publication Branch, 1925), p. 66; Keenan, *Steel Man*, p. 134.

ii) The point is reinforced by the following quote in a volume brought out by the company in 1958: 'the Works have been almost completely Indianized and today there are less than half a dozen members of the covenanted staff, who have made themselves at home in India and endeared themselves to its people.' Verrier Elwin, *The Story of Tata Steel* ([Bombay], n.p.: [1958]) (British Library Shelfmark W 3092), p. 67.

[59] It should be noted that the numbers of covenanted workers rose again in the 1920s, but this should be seen against the massive expansion that the plant was then undergoing. According to Daniel Headrick, the highest number of foreigners was reached in 1924. Headrick, *Tentacles of Progress*, p. 372.

[60] Headrick, *Tentacles of Progress*, p. 371.

[61] Ray, *Industrialization in India*, p. 83; Ashby, *My India*, p. 299; Keenan, *Steel Man*, p. 14 and p. 45; Copy of letter from T.H. Holland to T.W. Holderness (Under Secretary of State for India) dated 21 August 1918, in Indian Tariff Board, *Evidence recorded during enquiry into the steel industry, Volume I: The Tata Iron and Steel Company* (Calcutta: Superintendent Government Printing, India: 1924), pp. 96-7. The last of these sources is hereinafter cited as ITB 1924.

was of a similar order to that between Britain- and India-recruited engineers in the PWD and Railways (e.g. see Chapter 4).[62]

Table 6.1: *Covenanted and uncovenanted employees of TISCO in various years*

Number and average pay (aggregate of coke ovens, blast furnaces, open hearth, blooming mill, 28" mill and bar mills)

Year	Covenanted employees	Total wages and bonus (Rs.)	Average annual pay (covenanted) (Rs.)	Uncovenanted employees	Total wages (Rs.)	Average annual pay (uncovenanted) (Rs.)
1912-13	140	459,714	3,284	3,917	863,144	220
1915-16	75	637,784	8,498	4,243	1,120,284	264
1921-22	74	964,592	13,035	9,924	2,979,948	300

***Source*:** Calculated from tables in Indian Tariff Board, *Evidence recorded during enquiry into the steel industry, Volume I:The Tata Iron and Steel Company* (Calcutta: Superintendent Government Printing, India, 1924), Statement No. I, pp. 109-11. For rates of bonus, see *ibid.*, pp. 198-200.

Note: The figures for number of employees in this table are not strictly comparable with those for the following decade, by which time the extensions to the plant had become operational.

The second factor that encouraged the creation of training facilities for Indians was related to TISCO's postwar plea for economic protection. While the colonial government granted the company's request for interwar protection from cheap Belgian and German steel imports by raising protective tariffs,[63] in return TISCO had to submit to periodic scrutiny by the Indian Tariff Board (ITB). The ITB had to be satisfied that the company was doing all it could to justify the burden on the Indian consumer, who would pay higher prices for steel, and the Indian taxpayer, whose money would be used for bounties granted to TISCO in this period. The company was expected to demonstrate that it was keeping its costs down, and the Tariff Board saw the replacement of expensive foreign employees by Indians as one of the ways to do this.[64]

[62] Evidence of J.C.K. Peterson, T.W. Tutwiler and R.D. Tata at Jamshedpur, 18 August 1923, to the Indian Tariff Board, ITB 1924, p. 275ff, here p. 280. The similarity with government service was noted by the President [of the ITB] during this interview. *Ibid*.
[63] T. Roy, *The Economic History of India*, p. 235.
[64] Evidence of Peterson, Tutwiler and R.D. Tata, ITB 1924, p. 280.
[64] Evidence of Peterson, Tutwiler and R.D. Tata, ITB 1924, p. 280.

Further, in the opinion of one ITB official, 'there [was] no question in which the tax-payer [was] more keen than the scope for employment of Indians.'[65]

Third, the company had inaugurated a major expansion project in 1916, following upon the government's high consumption of TISCO steel and the establishment of other steel-consuming industries during the war.[66] As we saw earlier, the Greater Extensions aimed to increase the existing output of the works by a factor of five, and over the next few years it commissioned new plants that used improved production techniques such as the duplex process.[67] Although more foreign workers were recruited to fill the new crews,[68] importing experts was an expensive option. Consequently, the company needed as many qualified Indians as it could get.

Fourth, university courses in metallurgy, mechanical engineering and electrical engineering were still rare in India. The major engineering colleges at Roorkee, Madras, Sibpur and Poona were primarily intended to produce civil engineers for government service.[69] In the interwar period courses in metallurgy and mechanical engineering began to be offered at privately run institutions such as the Banaras Hindu University and the Bengal Technical Institute, but these were few and far between.[70]

All these factors favoured the establishment of new, in-house training facilities for Indians. They also dictated the form that such training should take: a combination of university-style theoretical learning with practical apprenticeship in the works. As early as 1916, the Tatas initiated an idea for a metallurgical school in Sakchi, offering a course of two years' theoretical instruction and two years' industrial apprenticeship. According to the proposal, the Bihar & Orissa Government would set up the school, the TISCO works would be used as a site for practical training, and students who passed out would add to the industrial manpower of the

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[65] See the exchange between Dr. Matthai (ITB) and Mr. Peterson (Tata Sons) in Indian Tariff Board, *Evidence recorded during enquiry regarding the grant of supplementary protection to the steel industry* (Calcutta: Government of India Central Publication Branch, 1925), pp. 102-3. The quote is from Dr. Matthai on p. 103.

[66] Ray, *Industrialization in India*, p. 87.

[67] Lala, *Romance of Tata Steel*, pp. 37-9; Keenan, *Steel Man*, p. 68; *First report of the Indian Tariff Board regarding the grant of protection to the steel industry* (place and publisher illegible: [1924]), p. 7. (Accessed via Digital Library of India, www.dli.ernet.in, on 2 January 2012.)

[68] Headrick, *Tentacles of Progress*, p. 372.

[69] Arun Kumar, 'Colonial Requirements and Engineering Education: The Public Works Department, 1847-1947' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995), pp. 216-232.

[70] Table 6.5 below has more on the courses offered at these two institutions.

province, some of them obtaining jobs in TISCO itself.[71] The plan was placed before the Indian Industrial Commission and met with its 'general approval',[72] but, for reasons that are not clear, did not come to fruition. However, it provided the template for a plan that did materialise.

This was the Jamshedpur Technical Institute (JTI). Set up in 1921 under the primary control of the Tatas, it comprised 'laboratories, lecture halls, classrooms and a library'.[73] It was not meant to be a 'trade' or 'industrial' school, the sort that typically admitted boys from an artisanal background and taught them a practical skill like blacksmithy or carpentry, or other semi-skilled factory work.[74] Instead, it was designed to produce employees rich in theoretical knowledge as well as practical experience, who would be fit to take on supervisory and managerial roles in the TISCO plant. The JTI's existence in the interwar period may be viewed as having two distinct phases falling on either side of the year 1935. I will discuss each in turn.

The JTI's first phase: the three-year programme

In the first phase of its existence, 1921-34, the Jamshedpur Technical Institute ran a three-year training course for students of university-going age. The structure of the course and the selection of staff and students were such as to enable a combination of scientific education and hands-on work. The instructors were university-trained men, including two (presumably British) Assistants, both Bachelors of Metallurgy from Sheffield, and an Indian B.Sc. (Calcutta). The Director of the Institute, W. Saunders, also had a Sheffield connection: he had been an apprentice at Vickers Ltd. in that city, in addition to holding a B.Sc. from London.[75] It is not clear whether the search for senior staff included the USA and other countries, but correspondence of the time confirms that advertisements were placed in the *Times* in Britain and 'private enquiries' made at British universities.[76] Some years later, the British instructors were joined by Indians who played important roles in the running of the JTI. S.N. Roy, one of the students of the JTI's 1922 batch, joined the staff of the Institute briefly upon graduation.[77]

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[71] Evidence of F. Walford, Witness No. 40, in Indian Industrial Commission (IIC), *Minutes of Evidence 1916-17, Volume I: Delhi, United Provinces and Bihar and Orissa* (Calcutta: Superintendent Government Printing, 1917), pp. 316-8.

[72] *IIC Report*, p. 133, paragraph 172. It must be noted here that one of the Commission's members was Dorabji Tata, Chairman of Tata Sons (*ibid.*, p. xvi), although it is not known if he participated in this particular decision.

[73] Keenan, *Steel Man*, p. 135.

[74] See Evidence of F. Walford in IIC, *Minutes of Evidence*, p. 315, on the nature of 'industrial schools'.

[75] Statement No. IX, ITB 1924, p. 121.

[76] **[**H. Treble] to S.M. Marshall, TISCO, 24 March 1921, Folder: T1/A1, 1921 to 1960, Box: Technical Training, T1/A1 (1921-60), A1 (1962-4, 1965-8, 1966-84), TSA.

[77] Statement 108, Enclosure (2), *The applications received by the Indian Tariff Board from the Tata Iron and Steel Company, Limited, and other companies in connection with the Statutory Enquiry regarding the grant or continuance of protection to the Steel Industry in India after the 31st March 1927, together with*

Continuing the Sheffield motif, he was then sent with a scholarship from Dorabji Tata to Sheffield University, where he earned a B.Met. degree before returning in 1928 to take up the post of Instructor at the JTI.[78] Roy later went on to become Superintendent of Training (i.e. head of the JTI).[79] Another Indian who took a keen interest in the Institute was P.N. Mathur, who in his days at Ford had conducted classes in Metallography for his colleagues. Mathur served as President of the Technical School Committee.[80]

As for students, the JTI invited applications from school-leavers with a science background: candidates had to have passed the Intermediate Science (I.Sc.) examination (administered at the end of a two-year course between school and university levels). These students would naturally be literate in English and of university standard. No prior factory experience was required, as the JTI's course itself provided for in-depth practical learning.

In the first two years of the three-year course of instruction, students alternated between the Institute (where they were instructed in theoretical subjects) one week and the TISCO works the next (first as observers, then as apprentices). In the third year, having gained a firm theoretical knowledge base, they were apprenticed full-time to the works. During their practical training students reported to the Works Superintendent, while their overall responsibility was to the Institute. After the second year, students decided to specialise in a particular branch of steel-making: coke ovens, blast furnace, open hearth, or sometimes rail mills.[81] Unlike the gentleman-generalist engineer of the PWD, the steel expert in the making was expected, from this point on, to concentrate all his energies on his chosen specialism. He had to familiarise himself with 'all the technical literature ever published in England, Germany, France and the United States, so that he becomes a sort of walking encyclopedia on [his chosen subject]', able to answer any question put to him by the superintendent to whom he was apprenticed in the works. In time the student must be able to recall relevant information at a moment's notice, for '[b]y the time he [had] a second thought in an emergency, he may be too dead to need it.'[82]

Like the other steel experts, the students of the JTI had to be in excellent physical condition: the ability to spend long hours in the works in high temperatures and potentially

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the questionnaires issued by the Board and other relevant papers (Calcutta: Government of India Central Publication Branch, 1926), p. 160. This source is hereinafter cited as ITB 1926.

[78] W. Saunders, JTI Director, to the TISCO General Superintendent, 26 October 1927; S.N. Roy (in Sheffield) to JTI Director, 13 November 1927. Both letters in Folder: T1/A1, 1921 to 1960, Box: Technical Training, T1/A1 (1921-60), A1 (1962-4, 1965-8, 1966-84), TSA.

[79] See S.N. Roy's designation in several memos/ letters sent by him in 1937 and 1938 in B.K. Mukherjee File, Folder: 1937, Box: Technical Training: A & B Class Apprentices, 1937, '38 and '39 batches, TSA.

[80] Capt. B. Dayal, 'Prem Narain Mathur (An Appreciation)', *TISCO Review*, May 1940, pp. 390-2; Keenan, *Steel Man*, p. 139.

[81] Evidence of Saunders, JTI Director, in ITB 1924, pp. 302-5; Keenan, *Steel Man*, pp. 135-6.

[82] Keenan, *Steel Man*, p. 136.

dangerous situations was as important for potential officers as it was for the plant's workers. To this end a medical examination was an important part of the selection process for entry to the Institute. Further, in promoting students from one year to the next, special consideration was given to students who were physically tough and industrious in the plant even if they were below par in their theoretical studies.[83] Students were also encouraged to play sports in their free time.[84]

The JTI was not a profit-making organisation but one designed to train employees for the TISCO works, moulding them according to the company's needs. The students were charged no fees, received a stipend of Rs. 60 a month, and were given subsidised lodging. The company provided them with the necessary books, which they paid for later if they were selected for a job in the works upon graduation.[85]

Although it was run primarily by the Tatas, the Institute received financial support from some provincial governments during the first decade of its existence (see below). Table 6.2 shows details of the costs of running the JTI, and external contributions, in the first two years of operation (1921-2 and 1922-3). The governments of Bihar and Orissa (Rs. 25,000 per annum) and Bengal (Rs. 10,000 per annum) were the major contributors. The princely state of Mysore sent a few students, paying Rs. 2,000 per student; the Calcutta engineering firm of Bird & Co likewise paid for one student's training. (They were investing in personnel for their own use: sponsored students returned to work in Mysore state and Bird respectively after their training.[86]) Officials of the provincial governments also participated in the first stage of selection. Saunders, the Director of the JTI, reported that the Directors of Industries in Punjab and Madras examined candidates from their respective provinces and sent the best qualified ones on to Jamshedpur, where they came before a Selection Committee for a further round of elimination and a medical examination.[87]

[83] See Saunders's evidence, ITB 1924, p. 303.
[84] Keenan, *Steel Man*, p. 135.
[85] Saunders's evidence, ITB 1924, p. 304.
[86] For examples of students transferred to Mysore Distilleries and Bird & Co upon graduating from the JTI, see Statement No. 108, Enclosures (1) and (2), ITB 1926, pp. 159-60.
[87] Saunders's evidence, ITB 1924, p. 303.

Table 6.2: *Expenditure on and contributions to the Jamshedpur Technical Institute in its first two years*

	1921-22 (Rs. – Annas – Paise)	**1922-23 (Rs. – Annas – Paise)**
Recurring expenditure	42,710 – 5 – 0	71,009 – 3 – 3
Contributions		
Mysore	4,800 – 0 – 0	4,800 – 0 – 0
Bihar & Orissa	8,333 – 5 – 4	25,000 – 0 – 0
Bengal	-	10,000
Bird & Co.	-	1,375 – 0 – 0 *
Sir Ratan Tata Trust	-	15,000 – 0 – 0
Remainder, borne by Steel Company	29,576 – 5 – 8	14,834 – 3 – 3
Actual Capital Expenditure	130,519 – 4 – 8	11,277 – 0 – 8
Receipts from Bihar & Orissa	100,000 – 0 – 0	-
Remainder, borne by Steel Company	30,519 – 4 – 8	11,277 – 0 – 8

Source: Indian Tariff Board, *Evidence recorded during enquiry into the steel industry, Volume I: The Tata Iron and Steel Company* (Calcutta: Superintendent Government Printing, India, 1924), Statement No. IX, p. 121.

*This figure is marked 'No stipend' in the source. This probably means that the amount paid was sufficient to cover the expenses of the student sent by Bird & Co., but did not include a stipend for the student.

The provinces' decision to contribute monetarily to the Institute may be understood in the light of the constitutional reforms of 1919, which had introduced the system of dyarchy, and made Industries a 'transferred' subject under provincial ministers.[88] Possibly the provincial governments wished to promote the JTI as an opportunity for industrial training for their candidates (some seats were reserved for candidates from donor provinces). Certainly in the case of Bihar and Orissa, technical colleges of the province sent their students to the JTI and TISCO to complete the apprenticeship component of their course. These students were also paid stipends and in some cases employed in the works at the end of the apprenticeship, but their programme of training was distinct from the regular three-year course of the JTI.[89] It will be recalled that the Bihar government had itself originally planned to establish a new institute, the students of which would undergo practical training at TISCO. It is plausible that by contributing monetarily to the JTI, they were seeking to achieve a similar objective at a lower cost.

[88] A.Z.M. Iftikhar-ul-Awwal, *The Industrial Development of Bengal: 1900-1939* (Delhi: Vikas Publishing House, 1982), p. 59.
[89] Files of various students, Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches, TSA.

From the start the JTI (and the prospect of TISCO jobs afterwards) proved immensely popular. The aim was to select around 25 students each year,[90] but the demand for places was many times greater. When applications were invited for entry in the second year of the JTI's operation, more than 2,600 candidates applied from numerous provinces and princely states across India (see Table 6.3).

Table 6.3: *Applicants to the JTI for November 1922, by province/ princely state*

Province	**No. of application letters**	**No. of students with good physique and otherwise qualified [i.e. I.Sc. diploma and approved by province]**
Bihar & Orissa	224	23
Bengal	885	64
Central Provinces	57	-
Madras	641	29
Bombay	63	4
United Provinces	173	7
Assam	43	6
Punjab	380	31
Central India	11	1
NW Province	13	-
Berar	1	-
Mysore	53	1
Burma	2	-
NW Frontier Province	11	1
Coorg	8	1
Baroda	4	-
Deccan	9	-
Cochin	14	2
Indore	3	-
Travancore	8	2
Cooch Bihar	2	-
Bikaner	1	-
Ajmer	8	-
Sindh	4	-
Kashmir	14	-
Jodhpur	3	-
Rajputana	3	-
Total	2,638	172

Source**:** Indian Tariff Board, *Evidence recorded during enquiry into the steel industry, Volume I: The Tata Iron and Steel Company* (Calcutta: Superintendent Government Printing, India, 1924), p. 123.

[90] Saunders's evidence, ITB 1924, p. 303.

The Institute was extremely selective. Table 6.3 shows that only 172 candidates of the 2,638 who applied for admission in 1922 were shortlisted to go to Jamshedpur for an interview. Following the interview, only 29 were finally admitted to the JTI. The programme was challenging, and several students could not keep up with it and had to leave the Institute.[91] Of the students admitted in the 1921 and 1922 batches, only fifty per cent graduated successfully. [92]

***Table 6.4**: Province-wise origin of JTI students until 1926*

	Graduated (as of 1926)		**In the Institute (as of 1926)**
Province	*1921 batch*	*1922 batch*	*Total (including 1923, '24 and '25 batches)*
Bihar & Orissa	7	4	21
Bengal	2	4	14
Assam	-	1	1
United Provinces	1	-	2
Madras	1	2	7
Central Province	1	-	2
Punjab	1	4	8
Bombay	-	-	3
Total	13	15	58

***Source*: *The applications received by the Indian Tariff Board from the Tata Iron and Steel Company, Limited, and other companies in connection with the Statutory Enquiry regarding the grant or continuance of protection to the Steel Industry in India after the 31st March 1927, together with the questionnaires issued by the Board and other relevant papers* (Calcutta: Government of India Central Publication Branch, 1926), Statement No. 108, Enclosure (5): 'Provincial List', p. 163.

The students of the JTI, as we have seen, came from all over the country. Table 6.4 shows that in aggregate terms, the largest number came from the provinces of Bihar & Orissa and Bengal. These were in a sense the 'home' provinces of TISCO (Jamshedpur was located in Bihar and not far from Bengal); and as we have seen, they both provided grants to the Institute (Table 6.2) and had places reserved for their candidates. In examining the JTI's figures, Professor V.G. Kale and Sir P.P. Ginwala of the Indian Tariff Board expressed surprise at the low share of Bombay students (with a reputation as an industrial centre rivalling that of Calcutta).[93] Possibly, alternative industrial opportunities in Bombay (with its textile mills) made the Institute less attractive to its students. In any event, very few applications were received

[91] Saunders's evidence, ITB 1924, p. 303.
[92] Statement No. 108, 'Jamshedpur Technical Institute: Notes on Institute Results', ITB 1926, p. 158.
[93] ITB 1924, pp. 304-5. For full listing of ITB members, see *First Report of the Indian Tariff Board*, p. 2.

from that province (32 for 1921 and 63 for 1922).[94] Ginwala and Kale's surprise underlines the fact that Bombay was the exception that proved the rule that JTI places were coveted. The company's statement furnished in response to their query underlines its high standards and the qualities it prized in applicants. Of the 63 applicants from Bombay for 1922, the statement said, only 4 were selected for the next round. Two of these went to Jamshedpur. One failed the medical examination, and the only one selected, T.R. Kapadia, went on vacation at the end of April 1923 and did not return. The statement concluded drily: 'It appears that he found the work too strenuous.'[95]

From the mid-Twenties, graduates of the JTI were ready to join the various departments and work their way up to the 'the more expert and responsible class of work'.[96] While they were not guaranteed employment in the Tata works, many of those who completed the course successfully were offered contracts. They began at a minimum of Rs. 200 a month, and were contracted for five years in the first instance.[97]

Most of these graduates began as foremen or assistant foremen[98] and moved up into the managerial grades within a few years. In 1926 the company reported that some of the JTI graduates who were now in the works (since 1924 or 1925) had already been promoted;[99] by 1928, three JTI graduates were 'actually operating furnaces'.[100] The rate of ascent through the ranks varied by the individual. One who rose rapidly was S. Sambasivan, who was appointed Chief Inspector in the Inspection Department upon graduation from the JTI.[101] In 1932 he was already Superintendent of the order department (the first JTI graduate to reach that rank).[102] In time others were promoted too. Keenan reported in 1943 that the current superintendents of the open hearth furnaces and the duplex plant were graduates of the first JTI batch.[103]

As early as 1926 the company reported to the Indian Tariff Board that 'the contracted men [i.e. JTI graduates] are building up an encouraging reputation which undoubtedly justifies the system being adopted.'[104] The Institute kept up a steady supply of personnel to the works in

[94] Statement No. IX, ITB 1924, pp. 121-2, here p. 122.
[95] *Ibid.*
[96] Statement No. 108, 'Jamshedpur Technical Institute: Notes on Institute Results', ITB 1926, p. 158.
[97] Evidence of Saunders and John Peterson, ITB 1924, pp. 302-5.
[98] Statement No. 108, Enclosure (1), 'Statement showing the Designation and Work of the Students who were recruited in 1921 for Metallurgical Apprenticeship and completed the course', ITB 1926, p. 159.
[99] Statement No. 108, 'Jamshedpur Technical Institute: Notes on Institute Results', ITB 1926, p. 158.
[100] Keenan, *Steel Man*, p. 140.
[101] Statement No. 108, Enclosure (1), 'Statement showing the Designation and Work of the Students who were recruited in 1921 for Metallurgical Apprenticeship and completed the course', ITB 1926, p. 159.
[102] *TISCO Review*, December 1932, p. 17.
[103] Keenan, *Steel Man*, p. 135.
[104] Statement No. 108, 'Notes on Institute Results', ITB 1926, p. 158.

the following years: as of 1932, the total number of contracts awarded stood at 88.[105] Furthermore, between two and four of the graduates from most years were sent for a further spell of specialised training in particular branches of steel manufacture in plants in Germany and England.[106]

John Keenan further endorsed the competence of the JTI graduates. In 1932, when he was General Manager, the management decided to set the JTI men a challenge. The effects of the Depression had begun to be felt and the pressure on production was reduced, so it was not critical to keep all the open hearth furnaces as well as the duplex plant running at full capacity. Some of the foreign technicians in the open hearth department were 'sent … home' (presumably this means they were dismissed or did not have their contracts renewed), and others were transferred to the duplex plant. A group of JTI graduates was placed in charge of the open hearth furnaces under the direction of Prem Mathur. 'Within a year', Keenan recalled, 'they were averaging 34,000 tons a month and had set a record for one month of 37,000 tons, or nearly double the American and British Tata record of 1919.'[107]

The JTI's second phase: the graduate trainee programme

Despite the success that attended the JTI's early years, a few problems emerged. To begin with, the inability of many students to complete the three-year programme suggested that despite the strict admission procedure, not all students possessed the required aptitude. Saunders, the Institute's Director, observed in 1924: 'We find that the I.Sc. [Intermediate Science] Indian qualification is not a very high qualification.'[108] To add to this, steel manufacturing in the following years was seen as relying increasingly on scientific theory, which also suggested the need to admit better qualified students. As the Superintendent of Training put it in 1935, 'the days of rule-of-thumb methods in industry have gone by.'[109]

Further, the obligation to take in a certain number of students from donor provinces meant that the Institute's management did not have an entirely free hand in the selection of students. This, Keenan implies in his memoir, was another factor diluting the quality of admitted students.[110] Finally, the JTI sometimes had to take on apprentices from provincial technical schools outside of its regular three-year programme. An incident that occurred in 1931

[105] TISCO Annual Report for 1931-2 (Directors' Report), p. 8. (Consulted at TSA.)
[106] See section on Technical Institute in Directors' Report, TISCO Annual Report, 1931-2 through 1933-4.
[107] Keenan, *Steel Man*, p. 140.
[108] Saunders's evidence, ITB 1924, p. 303.
[109] 'Technical Institute at Jamshedpur: Superintendent's Speech at Annual Prize Distribution', *TISCO Review*, July 1935, pp. 561-2, here p. 561.
[110] Keenan, *Steel Man*, p. 138.

indicates that the Institute found this arrangement one-sided, especially when its autonomy was challenged. In that year the Orissa School of Engineering in Cuttack sent four of its students to the TISCO works via the JTI for the start of a two-and-a-half-year apprenticeship. Soon after his first communication, Sohan Lal, the Principal of the Orissa School, wrote to amend the list, asking the company to accept a student named Mahadeb Naik in place of K.V. Gopala Rao.[111] While Lal insisted that Gopala Rao had been named '[b]y a mistake',[112] Saunders of the JTI suspected a different motive. Rao, he said in an internal memo, was 'the best of the bunch' sent from the Orissa School, and the Principal now wanted to replace him, 'obviously on second thoughts'. He suggested that Rao's roots in the presidency of Madras might be the cause of the changed decision.[113] During the ensuing negotiations, the company stressed its right to choose the better candidate (especially as he was the one sent originally), pointing out that it paid the apprentices a stipend for two and a half years (and might employ them at the end). 'In view of the facilities which this Company grants to the students from Ranchi Technical School and the Orissa School of Engineering, we do not think our request is unreasonable.'[114]

In order to address these challenges, the JTI was reorganised substantially starting with the 1935 batch of trainees.[115] The Institute now dispensed with the grants from provincial governments, and 'was free to pick men solely on merit and physical stamina.'[116] The I.Sc. was no longer a sufficient qualification to enter the Institute: the programme was redesigned as a two-year course for graduates.

The Institute was not limited any more to instruction in metallurgy, but also included electrical and mechanical engineering. According to the prospectus for the year 1936-7, students were classified as A1, A2 or B Class Apprentices according to their prior qualifications, as follows:

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[111] Sohan Lal (Principal, Orissa School of Engineering) to the General Manager, TISCO, 12 January 1931, K.V. Gopala Rao File, Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches, TSA.

[112] Sohan Lal to General Manager, TISCO, 28 January 1931, K.V. Gopala Rao File, Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches, TSA.

[113] W. Saunders to General Superintendent [TISCO], 19 January 1931, K.V. Gopala Rao File, Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches, TSA.

[114] Signed by H. Chew for General Manager, TISCO, to Principal, Orissa School of Engineering, 30 January 1931, K.V. Gopala Rao File, Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches, TSA. TISCO eventually won the argument and the Orissa School allowed Gopala Rao to continue his apprenticeship with the company. Sohan Lal to General Manager, TISCO, 2 February 1931, in the same file.

[115] Superintendent of Training to Superintendent S.M.S.3, 22 March 1961, B.K. Mukherjee File, Folder: 1937 Batch, Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches, TSA. See also Directors' Report in Annual Report for 1934-5, p. 8. (Consulted at TSA.) This is the first Annual Report to mention A and B Class apprentices.

[116] Keenan, *Steel Man*, p. 138.

B: 'A Degree or Diploma in Mechanical or Electrical Engineering or Metallurgy of a recognised Indian or Foreign University, Technical Institute or College.'

A1: 'An HONOURS or FIRST CLASS Degree or Diploma in Mechanical or Electrical Engineering or Metallurgy of a recognised Indian or Foreign University, Technical Institute or College, preferably accompanied by Works experience ABROAD.'

A2 (the highest class): 'An HONOURS or FIRST CLASS Degree or Diploma in Mechanical or Electrical Engineering or Metallurgy of a recognised Indian or Foreign University, Technical Institute or College, accompanied by not less than 6 months continuous practical experience after graduation in an IRON & STEEL WORKS ABROAD.'

The age limit to apply to the JTI was 27 years for graduates of foreign universities and 24 for those of Indian universities. A2 Class Apprentices could receive a stipend of up to Rs. 200 a month at the discretion of the company. A1 and B Class Apprentices were paid Rs. 75 per month and Rs. 50 per month respectively. Apprentices also received subsidised housing and 'free medical attention' (under certain conditions). A clause stated that admission would not in any way depend upon a candidate's province of origin or residence.

While the educational qualifications of entrants to the JTI were now higher than in the Institute's first phase and the course of instruction shorter, the programme maintained several of its essential features. As before, the course was a mix of theoretical instruction and practical training in the works.[117] Students passed through a vast number of departments for short periods of time before specialising in the work of any one department, where they would spend six months undergoing training.[118] The emphasis on physical fitness was unaltered: 'Applicants must be of robust physique and be fit to perform hard manual labour'. A student could be asked to leave the Institute if he 'fail[ed] at any time to satisfy the Management in regard to the standard of [his] work, conduct, attendance or health'.[119] In the application forms of several

[117] TISCO Ltd., 'The Jamshedpur Technical Institute: Prospectus: Session 1936-1937', A.P. Mitter File, Folder: 1937 Batch, Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches, TSA. In addition to the graduate trainee course, the Tatas' apprentice programme, in which sons of employees were trained in trades such as fitting, welding and machining, was merged with the JTI. These students were now termed C Class Apprentices. Keenan, *Steel Man*, pp. 137-8.

[118] See for instance V.M. Subramanian file, Folder: 1937 Batch, Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches, TSA.

[119] TISCO Ltd., 'The Jamshedpur Technical Institute: Prospectus: Session 1936-1937', A.P. Mitter File, Folder: 1937 Batch, Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches, TSA.

students (archived in their respective files), the entries against 'Proficiency in College Athletics' are specially marked in pencil, probably by a member of the selection committee.[120]

The average number of A and B Class apprentices admitted in each batch between the years 1936 and 1939 (both inclusive) was 13.[121] The educational backgrounds of some of the early graduate trainees, and the jobs they obtained later, are shown in Table 6.5 below:

[120] Files of students listed in Table 6.5 below. Sources are the same as those cited for Table 6.5.
[121] Calculated from figures in Directors' Reports appearing as part of the TISCO Annual Reports for the relevant years (TSA).

Table 6.5: *Profiles of some graduate trainees, JTI* [122]

Name and province of domicile	**Year of joining JTI (usually January)**	**Class of Apprentice-ship (if known)**	**Prior Qualifications***	**Job held (if known)**
A.P. Mitter (Bengal)	1937	B	Mechanical Engineering (4-year Diploma), **Jadavpur**	--
B.K. Mukherjee (Bihar)	1937	B	Electrical Engineering (Diploma), **Jadavpur**	As of 1961: First Converterman in New SMS.3 Bessemer Converter Section
V.M. Subramanian (Sind)	1937	A1	B.Sc. in Mechanical and Electrical Engineering, **BHU;** G.I.E.E. (membership received while in the Institute)	Assistant Sales Engineer, Wheel Tyre & Axle Plant (as of 1942); Assistant Sales Manager, TISCO, Madras (as of 1946)
U.A. Prabhu (Madras)	1938	B	B.Sc. in Metallurgy, **BHU**	Foreman, C1 Foundry (as of 1948)
N.K. Ganguly (Punjab)	1938	A1	Diploma of Maclagan Engineering College, Lahore (Electrical Engg) and B.Sc. in Engineering, Punjab University	--
K.P. Mahalingam (Bombay)	1942	--	Diploma in Mechanical Engineering, **VJTI**	--
P.V. Ramachandran (Madras)	1942	A1	B.Sc. in Mechanical and Electrical Engineering, **BHU**	Foreman Machine Shops I (as of 1946)

*The full names of the Colleges listed are as follows:
BHU: Engineering College, Banaras Hindu University, Banaras.
Jadavpur: College of Engineering and Technology, Bengal (known as Bengal Technical Institute until 1929), located in Jadavpur near Calcutta.
VJTI: Victoria Jubilee Technical Institute, Bombay.

Table 6.5 confirms the fact that courses in branches of engineering other than civil were still in their infancy in interwar India,[123] with only a select few colleges operating established courses in branches relevant to industry, such as electrical and mechanical engineering. All students listed in the table except N.K. Ganguly had obtained their degrees or diplomas in

[122] Files of the concerned students (including correspondence and applications for admission to the JTI), in

i) Folders: 1937 Batch and 1938 Batch, Box: Technical Training, A&B Class Apprentices, 1937, ’38, ’39 Batches, TSA.

ii) Folders: GT 1941 Batch, Box: Technical Training, Graduate Trainees 1941, ’44, ’45, TSA.

[123] See Arun Kumar, ‘Colonial Requirements and Engineering Education’, p. 228.

colleges that had been set up, and were funded, wholly or partially through private initiative. Indeed the college at Jadavpur had been established in 1906 as a result of the Swadeshi movement's boycott of colleges run by the colonial government.[124]

It appears that B Class Apprentices were expected to become middle level supervisory employees with the possibility of promotion, while A Class students were groomed to attain higher managerial positions (as indicated by the cases of B.K. Mukherjee and V.M. Subramanian in the table). Much, however, depended on the individual and his performance during the course of training (and, naturally, after employment). For instance, although A Class apprentices were usually offered a higher starting salary if employed at the end of the course, a B Class apprentice could in theory be offered the same salary provided his performance in the course reached the standard of an A Class student.[125]

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By all accounts the JTI helped the management successfully Indianise the works. As of 1938-9, 219 students had been trained in the JTI, of whom 202 were working in the company.[126] A recent study by Hiruyoki Oba and Hrushikesh Panda gives the number of covenanted personnel replaced by Indians in the period 1926-33 as 85,[127] a significant number given that the total strength of covenanted personnel in 1925-6 had been 199.[128] It follows that considerable savings were effected, as Indians were less expensive than their foreign counterparts even at the managerial levels. Oba and Panda estimate that expenditure on wages decreased 'by about 50%', which 'thereby led to sizeable reductions in the average cost of production of steel.'[129]

The JTI played an important role in the continued healthy performance of TISCO in the interwar period. With the help of economic protection, TISCO successfully withstood foreign competition, while domestic demand grew as a number of ancillary steel-consuming industries came up in Jamshedpur (e.g. Agricultural Implements Company; Tinplate Company of India, Limited; Indian Steel & Wire Products Ltd.; Jamshedpur Engineering & Manufacturing Co.).[130] TISCO's share of the domestic steel market by volume was 37.3 per cent in 1926; rose to 59.45

[124] On Jadavpur, see Jogesh Chandra Bagal, *Pramatha Nath Bose*, Chapter X. On VJTI, see *IIC Report*, pp. 105-6. The moving force behind the setting up of BHU was the Congress leader Madan Mohan Malaviya. BHU's engineering college was established in 1919. See Institute of Technology, Banaras Hindu University, 'Heritage', http://www.itbhu.ac.in/itbhu/heritage.shtml, accessed 9 June 2012.
[125] See correspondence in U.A. Prabhu file, Folder: 1938 Batch, Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches, TSA.
[126] This would include the three-year students before 1935, and the A and B Class apprentices thereafter. Directors' Report, in TISCO Annual Report for 1938-9, p. 8.
[127] Oba and Panda (eds.), *Industrial Development and Technology Absorption*, p. 73.
[128] Calculated from statements No. 57 to 70, ITB 1926, pp. 115-19.
[129] Oba and Panda (eds.), *Industrial Development and Technology Absorption*, pp. 81-2.
[130] Ray, *Industrialization in India*, pp. 77-8 and pp. 89-90; ITB 1924, p. 74.

per cent (431,000 out of 725,000 tons) in 1932-3, despite a fall in overall demand in the Depression years; and increased further to 66 per cent around the start of World War II.[131] During the war, the company began to produce a wide variety of steel products such as 'armour plates…, alloy, tool and special steels' and 'acid steels for turning out wheels, tyres and axles' for the railways.[132] The JTI did not become the only entry route to TISCO for technical experts—P.N. Mathur being an example of an experienced expert being recruited directly—but it became essential to the company's recruitment strategy. The availability of qualified Indian personnel at a rate that the company could determine, through the JTI, was crucial in cutting costs, convincing the government to continue the grant of protection, and running the expanded works after the Greater Extensions had been carried out. In achieving this, the JTI also established itself as one of the earliest industrial training facilities in the country. The three-year programme that it ran in its first phase, starting in 1921, anticipated by at least a decade the introduction of degree courses in mechanical and electrical engineering in most of the government engineering colleges.[133] This suggests that the two-year graduate trainee programme of the JTI's second phase was an exceptionally advanced programme in the context of 1930s India.

Conclusions

This chapter has explored the background, training, nature of expertise and work culture of technical experts in the Tata Iron and Steel Company (TISCO) in the interwar period. TISCO, one of the most important industrial enterprises of interwar India, was not only built by American engineers but also staffed by an international group of technical experts from various countries, of which the USA was the most prominent. The culture of steel-making in the company (whose works were inaugurated in 1912) was defined by this multi-national group of technical managers and supervisors, men of physical strength, many of whom had learnt their skills through practical training. When they were joined by a number of Indians—who had attended universities in the USA, Germany and Britain and been industrial apprentices in those countries—the culture of steel-making continued to emphasise the importance of practical experience, physical toughness and quick-wittedness in the works.

[131] R.K. Ray, *Industrialization in India*, pp. 87-8.
[132] *Ibid.*, p. 92.
[133] See Arun Kumar, 'Colonial Requirements', endnote 36 on p. 231 for the dates when these degrees were introduced at Poona, Sibpur and Madras.

The Jamshedpur Technical Institute (JTI) was central to the process of Indianisation that was undertaken in the interwar years, as the company sought to cut costs and obtain economic protection from the government. The graduates of the Institute were trained to replace foreign employees at the middle and higher levels of the works' personnel. The most important feature of the Institute's curriculum was its mix of theoretical learning and practical experience—students spent a substantial proportion of their training as apprentices in the TISCO works. Both at its inception, when it trained school-leavers, and from 1935, when it became a training programme for graduates in metallurgy and engineering, the JTI's management continued to prize physical fitness and practical experience in addition to academic achievement. These formed important criteria in the selection of students for the JTI and ultimately for jobs in the works. The resulting culture of industrial engineering, which privileged technical specialisation and shop-floor experience, was very different from the gentleman-generalist paradigm of PWD engineers and the government-bureaucratic culture in which railway engineers (including those on company-run railways) operated.

This study of industrial experts in TISCO has contributed to our wider understanding of industrialisation and Indianisation in three significant ways. First, it has added a vital dimension to economic histories of Indian industry, in which technical experts have not received adequate attention. I have shown in this chapter that in addition to economic protection, the ensuring of a steady supply of Indian experts was vital in enabling TISCO to effect savings and perform successfully through the interwar period. Second, the chapter has highlighted the importance of extra-imperial networks and influences in the history of industrial engineers in India. The multi-national team of experts who started up the works, American managers, machinery and consulting engineers, and Indians trained in America and Germany were all essential factors in the company's interwar performance.

Third, the chapter shows that the Indianisation of technical practitioners in interwar India occurred in diverse ways. In contrast to the case of government-employed engineers in the PWD and railways (as analysed in Chapters 4 and 5), the motivation for Indianisation in TISCO was largely internal and not so much the result of external demands by the public or by politicians. The engineers of the PWD and state railways belonged to public services, the Indianisation of which was actively monitored by Indian members of the central legislature. Their demands carried particular weight in the light of the Montagu–Chelmsford reforms, which had specified Indianisation as an important goal of government policy; yet in practice, government officials often resisted Indianisation, and always proceeded cautiously in implementing it. The case of TISCO was different. While the Tariff Board—which decided upon the award of protection to specific industries—required the company to show some

progress in Indianisation, this was an incidental factor, the main point of the investigation being the company's ability to cut costs and its potential for success under protection. Indianisation at TISCO was essentially driven from within. The company was owned by Indians; foreign experts had been employed mainly to help start up the works; Indian experts were considerably less expensive; and no quotas were set for Indians. As far as can be discerned from the correspondence and statements quoted here of the American General Managers such as Wells, Keenan and Tutwiler, there was no systematic prejudice against employing Indian engineers for the TISCO works. Finally, the company did not rely on the colonial education system as a source of Indian experts, using instead its own Institute, the JTI, in which many of the graduate trainees were products of a small number of privately run technical/engineering colleges.

Conclusion

This has been the first extensive historical study of the engineering profession in India in the years 1900-47—a profession whose members numbered in the thousands, were central figures in government bureaucracies as well as industrial enterprises, and operated across the length and breadth of the subcontinent. In drawing attention to these technical experts, this thesis has broadened the canvas to include actors other than the small number of political thinkers and scientist-intellectuals who usually feature in the existing historiography of STM in India. Whereas the majority of the literature has seen STM in India as a key to understanding the relationship between science, colonialism and ideas of modernity and nation, I have studied engineers in relation to two contemporary transformations in Indian history: industrialisation and Indianisation.

In this thesis I explored the functions and the (changing) organisation of engineers in three different areas: public works, railways, and private industry. (Military engineers, who were a sizeable presence in public works and railways, were also included in this analysis.) This was juxtaposed with a view of the rivalries within and the development of the engineering profession as a whole, reconstructed through an analysis of the role of professional institutions. The contested process of change—especially Indianisation—was in each case closely related to the multi-layered and continuously evolving colonial state in the interwar era of constitutional reforms. Below I present the main conclusions of the substantive chapters before identifying the broad conclusions that emerge from the thesis as a whole.

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I began by tracing the broad developments in the engineering profession through an analysis of the comparative importance of professional institutions in Britain and India. Two major conclusions were drawn. First, the profession grew in size over our period, and the share of mechanical and electrical engineers—most of them working in private industry—grew considerably in comparison to that of civil engineers, who had dominated the profession in India before World War I. This is indicated in the membership of the London-based Institutions of Civil, Mechanical and Electrical Engineers. This shift in the composition of the profession reflected the government's new economic policies—more favourable than before to the growth of large-scale industries—which in turn were a result of the changing economic and political relationship between Britain and its Indian empire in the interwar period.

Second, the membership trends of the London institutions revealed another shift, one that was crucially important in all branches of engineering: Indianisation. In all three London institutions, the percentage share of 'native' Indians among India-resident members increased considerably. The transformation, however, went beyond a mere increase in the number of Indian engineers. The creation of the Institution of Engineers (India) (abbr. IEI) in Calcutta in 1920, its recognition by the central and provincial governments, and its growth to prominence in the interwar period pointed to the formation of a nascent Indian identity in the engineering profession. Before World War I, engineers' identities had either been constructed as a part of the metropolitan/empire-wide engineering profession (through membership of the London institutions), or as specific to the elite government services (as in the case of the PWD Congresses founded in the twentieth century). By contrast, in the interwar period, key figures at the all-India and provincial levels of the IEI, whether Indian or British, consistently referred to the profession as being bound up with the cause of Indian economic development and industrialisation.

Having established the overall trends of industrialisation and Indianisation in the trajectory of the engineering profession, the rest of the thesis identified the complexities and conflicts involved in these processes, and the ultimate limits of change in the profession. These features came to light through detailed studies of engineers in different fields of government and industrial work.

Beginning with the Public Works Department, I demonstrated that although measures were taken in response to demands for more equal opportunities for Indians, inequalities persisted, and the rate of Indianisation was gradual. At the start of our period there were two separate engineering services, an Imperial Service (staffed by recruits from Britain) and a Provincial Service (recruiting in India), which differed in prestige and emoluments. In 1920, ostensibly to remove these distinctions, a new Indian Service of Engineers (ISE) was created, recruiting in India as well as Britain. Yet a new set of distinctions in allowances and privileges was introduced between India- and Britain-recruited engineers. Furthermore, new provincial services were created, below the ISE officers in the PWD hierarchy of each province, and it was in these services that most fresh opportunities were available for Indian engineers. In the elite ISE, Indian engineers approached a 50 per cent share in the late 1930s.

The misgivings of colonial officials and British policymakers about Indianisation came to the fore when first the Roads and Buildings branch and later the Irrigation branch of the PWD was provincialised (in 1919 and 1935 respectively). This meant that recruitment of engineers would be the concern of the provincial governments rather than the Secretary of State in London—and, consequently, that most new recruits would be Indians. I showed that opponents

of these changes suggested that Indians were deficient in courage, a sense of responsibility, and general character rather than in technical aptitude. During a 1935 debate in the House of Commons on recruitment to the Irrigation service, doubts were cast also on the integrity of Indian engineers, their ability to combat corruption, and their impartiality in the distribution of irrigation water.

These criticisms were directly related to the culture of public works engineering. The ideal PWD engineer was supposed to be a generalist and a gentleman—more specifically a British gentleman—whose character was as important as his technical ability. The training and recruitment of engineers, which had long been under the close control of the India Office in London, was designed to this end—as illustrated by the curriculum and lifestyle of students at the PWD-focused Cooper's Hill College near London. The near-monopoly of Cooper's Hill graduates on PWD (Imperial Service) appointments until the College's closure in 1906, the ubiquity of those graduates in the upper ranks of the ISE through to the 1930s, and the India Office's efforts to attract applicants with a similar pedigree after 1906 ensured that this culture pervaded the PWD. My more general point is that the public works engineer in our period is best understood as a particular type of colonial administrator. Whereas the historian David Gilmartin has stressed the conflicts between engineers and colonial administrators in their theories of governance in a specific context (the Indus Basin, after the construction of an irrigation canal network in the 1880s),[1] I have argued that in the context of the PWD as a whole, viewed across British India in the twentieth century, it is the similarities between the functions and culture of engineer officers and that of other civil servants that stand out.

If Indianisation in the PWD was related to provincialisation, in the railways it was closely associated with demands for the *nationalisation* of company-run lines. Historians such as Ian Kerr have stressed that the demands of nationalist politics drove the history of the railways in the years 1900-47. In this thesis I have concentrated on analysing the response of the colonial government, in particular their resistance to change in the Superior Services (officer positions) of the railways. Although the Acworth Committee (1920-21) decided in favour of nationalising the company-run railways, it did so only by a slender majority (the Chairman's casting vote). The Committee's minority and other critics opposed nationalisation on the grounds that efficiency would suffer, that democracy did not lend itself to good railway management, and that the organisation would become inflexible. Further, nationalisation did not necessarily lead to greater Indianisation as was expected.

[1] David Gilmartin, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', *The Journal of Asian Studies*, Vol. 53, No. 4 (November 1994), pp. 1127-49.

Following the recommendations of the Islington Commission (1912-15) and Lee Commission (1923-4) , the government had set a target of recruiting fresh officers in the ratio of 3 Indians to every European, with the aim of achieving a 50-50 composition overall as quickly as possible. These recruitment targets, which were to apply to company-run as well as state-run railways, were consistently missed, and it was only in the late 1930s that Indians made up one half or more of the Superior Services. Even this result was due not only to the recruitment of more Indians, but also to the departure or retrenchment of Europeans during the Depression years and after the start of World War II. In demonstrating this, I support Daniel Headrick's claim that Indianisation was partly the result of external factors. While Headrick's argument was made for railway employees as a whole, my statistical analysis has confirmed that it also applies for the specific case of Superior Service officers.

My analysis has also shown that Indianisation was pursued selectively, in such a way as to ensure continuity in the top echelons of the railway bureaucracy, while allowing a notable degree of change in the middle and lower levels. New facilities set up in the interwar period for the training of Indians concentrated upon the Traffic and Mechanical Engineering departments of the railways, while no fresh measures were introduced to train Indians for the more prestigious and powerful civil engineering positions. Correspondingly, the proportion of Indians among fresh recruits to the engineering department was lower than that in the other departments of the railways. As in the case of the PWD, Indianisation had its vocal opponents and sceptics. The arguments here were slightly different, though: in the place of integrity and impartiality, 'efficiency' was invoked: railways were to be run on business principles, and British engineers with practical experience on railways in their home country were better candidates to run the Indian railways efficiently. Additionally, the spectre of sabotage was raised: it was argued that the railways, being the strategic lifeline of the Empire in India, required the dominant presence of 'loyal' (i.e. European) engineers.

While the key to the recruitment of Indians in the PWD and railways lay with the colonial government and its engineering colleges in India, private industry had other options, as shown by the case of the Tata Iron and Steel Company (TISCO), the premier heavy industrial enterprise in interwar India. TISCO's initial dependence on government patronage and the grant of economic protection notwithstanding, the company's recruitment and training of its technical personnel had an important extra-imperial component. In the beginning the company imported experts from several countries, primarily the USA; a generation of Indians trained in Germany and the USA then occupied important positions in the company; and after World War I, the company successfully set up and ran its own post-graduate training school, the Jamshedpur Technical Institute (JTI), to train Indians for supervisory positions in the works. Many of the

entrants to the JTI (and thence to TISCO) were graduates of colleges associated with nationalist leaders (e.g. the Banaras Hindu University, and the Bengal Engineering College, Jadavpur).

The importance of relationships beyond the confines of Empire has recently been highlighted by historians, as in Ross Bassett's study of a small group of Indians who went to the Massachusetts Institute of Technology to train as engineers and technologists, funded largely by princely rulers from the Kathiawar region, returning to set up Swadeshi industries in India or participate in nationalist agitations.[2] My study of TISCO has revealed the features of another important tribe of America-trained Indian engineers—experts who did not necessarily participate directly in the nationalist movement or aim to set up completely indigenous industries, but worked in a large-scale industry which, while owned by Indian capital, maintained a close working relationship with the colonial government.

The experience of TISCO differed in other ways from that of the government services. Indianisation here was largely an internal process, driven more by concerns of economy than by political demands. Further, a different work culture prevailed in place of the ideal of the gentleman engineer. The steel works were a place for unpretentious specialists with practical knowledge, stamina and the willingness to work with their hands. Elements of this culture, which first took shape under the early generations of foreign experts who had learnt their skills by apprenticeship in the steel mills of their own countries, were continued and institutionalised in the subsequent generation of schooled engineers (as seen in the training programme at the JTI).

Overall Conclusions

Taken together, these specific findings reveal several broad patterns that demonstrate the utility of the approach to HSTM adopted in this thesis.

To begin with, this thesis has stressed the need for placing practitioners at the centre of the history of STM in India. Focusing thus on engineers and their professional concerns has led us to a deep engagement with the bureaucratic structure of government services and large-scale private industries, and their systems for the recruitment and training of technical experts. This has enabled us to see science and technology in the period 1900-47 not just as a harbinger of modernity or as a knowledge system, but also as the exercise of functions of fundamental administrative and economic importance. The practice of technology was as much a question of

[2] Ross Bassett, 'MIT-Trained Swadeshis: MIT and Indian Nationalism, 1880–1947', *Osiris*, Vol. 24, No. 1 (2009), pp. 212-230.

career, status and Indians' desire for a role in government as it was about 'knowledge' or the building of a nation.

This study has deliberately focused on the twentieth century, to which a relatively small section of the historiography of STM in India is devoted. I have sought to take into account, and contribute to our understanding of, the fluid nature of the Indian economy, polity and society in this period, and the multiplicity of competing but interdependent actors and interests. By examining the role of engineers in these transitional decades between Victorian colonialism and Indian Independence, this thesis has questioned the utility of essentialised categories like 'colonialism' and 'nationalism' in understanding the history of science in India. As this thesis has shown, it is neither useful nor accurate to view the science and technology of the state as necessarily 'colonial', to be placed in opposition to a nationalist movement that is considered as operating entirely outside the state machinery. On the contrary, the Indian politicians in the provincial and central legislatures were themselves part of the state; and their demands for Indianising the public works and railway engineering services amounted to their wanting more Indians to work for the state. My study of TISCO's technical experts has shown a similar blurring of categories. The company cannot easily be bracketed as loyalist or nationalist.[3] It maintained a close working relationship with the colonial government, supplying it with steel rails during the Great War and obtaining economic protection from it in the 1920s and '30s. Yet TISCO circumvented (or had little use for) the main state-run engineering colleges in sourcing technical personnel for its works in Jamshedpur. Indeed the engineering profession at large, as represented by the Institution of Engineers (India), evolved an Indian identity while remaining wedded to the colonial state. The creation of the Institution followed the recommendation of a government-appointed body, and had the ultimate form of official recognition in the form of its 1935 Royal Charter. Yet the Institution was encouraging of Indianisation and the promotion of industries, and the engineers who occupied leadership roles within the organisation increasingly articulated their belief in a form of economic nationalism.

I have also emphasised in this study the need to pay close attention to the two-way relationship between STM and the heterogeneous and evolving colonial state in our period. On the one hand, I have shown how the careers and professional opportunities of engineers were impacted by the constitutional reforms occurring in 1919 and 1935. Indian members of the expanded Legislative Assembly were instrumental in pushing the Indianisation agenda in the

[3] On a related note, see Vinay Bahl's labour history of TISCO, one of the themes of which is the company's successful maintaining of relations both with the colonial government and with nationalist leaders as it tackled a series of major strikes. Vinay Bahl, *The Making of the Indian Working Class: A Case of the Tata Iron and Steel Company, 1880-1946* (New Delhi, Thousand Oaks and London: Sage, 1995).

railways: the setting of quotas for Indian recruitment under the Lee Commission and the subsequent annual reporting of progress in that direction could probably not have occurred in the India of earlier decades. The newly empowered provincial governments (which were in charge of Industries from 1919) also played a role in the case of private industrial enterprises like TISCO. The Jamshedpur Technical Institute was (in its early years) funded partially by the governments of Bengal and Bihar & Orissa, and continued to have a relationship with provincial technical colleges into the 1940s, accepting students from them for its trainee schemes. On the other hand, I have also shown that the actual implementation of constitutional reforms was a contingent process, whose particular form often depended on the state's understanding of the role of its engineer (and other) officers. When Roads & Buildings was provincialised after World War I, it raised the question: to whom would public works engineers be responsible—to the Secretary of State, to the Government of India, or to the government of the province in which they were working? In the event, while fresh recruits were made responsible to provincial ministers, the retention of the existing ISE officers under their old terms was considered essential to maintain continuity. Similarly, when the Irrigation branch was provincialised after 1935, the Secretary of State reserved the right to make appointments to it in exceptional cases. Provincialisation, in both cases, came with caveats and qualifications.

The present study has confirmed that Indianisation was a ubiquitous theme in the years 1900-47, relevant in all the sectors in which engineers worked. Debates, whether on the provincialisation of the PWD's Irrigation branch or the nationalisation of company-run railways, hinged on the participants' views on Indian engineers and whether they could successfully replace Europeans. Examining the process of Indianisation has further shown that the question of race was central to the experience of professional engineers in our period, even if it was not always referred to directly. The initial Imperial/Provincial distinction, the multiple Royal Commissions on Indianisation, the prescribing of quotas for recruitment in Britain and India (in some cases) and of Europeans and Indians (in others), were all manifestations of this fact. The debates on Indianisation give us a clue as to how race was understood in relation to technical practitioners. The race of an engineer was commonly associated with many qualities: gentlemanliness, integrity and courage (in the PWD), 'efficiency' and loyalty to the colonial regime (in the railways), but seldom directly with technical competence.

Further, the thesis has demonstrated the utility of a little-used approach to the study of industrialisation in interwar India. As my study of the steel experts of TISCO suggests, focusing on industrial engineers can help us understand various facets of the interwar growth of large-scale industry, including the state of industrial education in the country, the role of international linkages in the flow of experts and machinery, the relationships of industries with the colonial

government on the one hand, and with provincial governments on the other (Industries being a transferred/provincialised subject in the interwar period). The experts who carried out the daily operations of TISCO were at the heart of its activities: economic protection and the state of international trade in the interwar period doubtless played an important part in TISCO's success, but would have been of little use if the company had not been able to find a way to procure technical experts. In turn such studies, seen in conjunction with studies of government services, tell us a great deal about the differing experiences of engineers across sectors, and about the increasingly diverse range of activities that constituted engineering in India over the course of the interwar period.

Thus, structuring this study of engineers around the themes of Indianisation and industrialisation has not only revealed important aspects of those two processes, but also served to situate the history of engineers in India within the broader framework of Indian history.

Future Research

Future research could profitably extend the work presented in this thesis in four main directions. First, the picture drawn here of Indian engineers' training and qualifications—whether in the government engineering colleges, in universities in the USA, or in the Tata steel company's in-house technical institute—might be extended further to explore their socio-economic backgrounds. This would be valuable in further understanding their perception of and response to the work culture in the organisations they entered—particularly in the government services, whose predominant culture as shaped by British engineers from the military, Cooper's Hill and other British institutions has been described here. Daniel Klingensmith has indicated the importance in Punjab of reformist social and educational movements like the Arya Samaj, which helped create a 'modernist, professionalized Punjabi middle class', from which came A.N. Khosla and Kanwar Sain, the two main engineers who feature in his study of large dam projects and the discourse of development.[4] The phenomenon of a new professions-oriented class in Punjab is vividly described in *Punjabi Century*, a well-known memoir by Prakash Tandon (himself the son of a PWD engineer),[5] and also referred to in a recent memoir by Jagman Singh (an engineer on the Bhakra project in Punjab).[6] Research exploring whether

[4] Daniel Klingensmith, *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007), Chapter 5. The quoted text is from p. 226.
[5] Prakash Tandon, *Punjabi Century: 1857-1947* (London: Chatto and Windus; Toronto: Clarke, Irwin and Co, 1961).
[6] Jagman Singh, *My Tryst with the Projects Bhakra and Beas* (New Delhi: Uppal Publishing House, 1998), esp. p. 59.

similar processes operated in other regions of India would be useful in further understanding the emerging class of Indian engineers.

Second, other industrial ventures may be studied in addition to the case study on TISCO carried out in this thesis. While preliminary evidence suggests that similar features (foreign experts in the beginning, Indians trained in the USA) were to be found in other emerging industrial enterprises, detailed studies of some of them would be invaluable in establishing larger patterns. Among the possible subjects for such studies is the Kirloskar group, which manufactured agricultural implements at its industrial township near Poona. As in the case of TISCO, a strong American influence operated here. The founder, Laxmanrao Kirloskar (a former instructor at Bombay's Victoria Jubilee Technical Institute) had been a subscriber to *American Machinist* in his youth, and sent his son Shantanu (who later headed the company) to the USA to study engineering at the MIT.[7]

Third, the research undertaken here on British India may be extended to include the princely states. Some of the larger princely states had their own industries and a sizeable population of engineers—Mysore being the prime example. While the present work has concentrated upon British India, the intertwined technological histories of British and princely India has been indicated (for instance, TISCO obtained access to iron ore from the Maharaja of Mayurbhanj, and trained students sent by the Mysore government to the JTI). The princely states, while ultimately responsible to the British authorities in India, had a degree of autonomy in internal matters. Further research would explore if and how this affected the professional organisation and conditions of work of engineers in the Mysore services and the state's industries. A key figure in this regard, M. Visvesvaraya (an engineer who retired from the Bombay PWD in the early twentieth century and returned home to Mysore, where he became a technocratic administrator with a vision for industrialisation), has been studied only briefly by historians, and further work would need to extend the historical understanding of his role.[8]

A fourth direction in which this study may be extended is temporal. The early post-Independence decades promise to be a fruitful time-period in which to study the relationship between engineers and the state. The first independent governments under Nehru, in their policies on technical education (broadly defined), inherited elements of the approach both of their nationalist forebears and of the colonial government.[9] In the particular context of the education of professional engineers, Kim Sebaly has studied the origins of the Indian Institutes

[7] S.L. Kirloskar, *Cactus & Roses: An Autobiography* (Pune: C.G. Phadke, 1982).
[8] Dhruv Raina, *Visvesvaraya as Engineer-Sociologist and the Evolution of his Techno-Economic Vision* (Bangalore: National Institute of Advanced Studies, 2001).
[9] See Aparajith Ramnath, 'Breaking free: Technical education policy in India immediately before and after Independence' (M.Sc. dissertation, University of Oxford, 2007).

of Technology (IITs), which became the most prestigious engineering institutions in the post-Independence years.[10] Further research would study how these education facilities related with the employment opportunities in the 1950s and '60s, not only in government services and private industries, but in the new public sector heavy industries that were inaugurated in this period.

[10] Kim Patrick Sebaly, 'The Assistance of Four Nations in the Establishment of the Indian Institutes of Technology, 1945-1970' (PhD thesis, University of Michigan, 1972).

Bibliography

PRIMARY SOURCES

Archival/ Unpublished Collections

Tata Steel Archives, Jamshedpur

'A Chart showing the Organisation of the Staff, both administrative and departmental with the monthly Expenditure of each Dept.', undated diagram [estimated interwar period].

Box 51: Private Papers, R. Mather.

Box 69: 'Private Papers: P.N. Mathur'.

Box: General Manager's Correspondence, 1909.

Box: Technical Training, A&B Class Apprentices, 1937, '38, '39 Batches.

Box: Technical Training, Graduate Trainees 1941, '44, '45.

Box: Technical Training, T1/A1 (1921-60), A1 (1962-4, 1965-8, 1966-84).

Box: Technical Training: Bihar & Orissa Apprentices, 1927-33 Batches.

Asia Pacific and Africa Collections (APAC), British Library

G.F. Hall, 'All in the Day's Work' (typescript, 2 vols., 1947), APAC: MSS Eur D569/1 and D569/2.

ICE (Institution of Civil Engineers) Archives, London

'The Institution of Civil Engineers: Advisory Committees', Accession Number: 185/01.

Memorandum on 'Election of Colonial Representatives on the Council', Accession Number: 185/01.

J.W. Mackison to A. A. Biggs, 30 March 1926, supporting proposal for a Local Association of the ICE in India, Accession Number: 185/03.

R.D.T. Alexander to Secretary of the ICE, 26 April 1926, part of the ICE's official correspondence of 1926 considering the creation of a local centre in India. Accession Number: 185/03.

IET (Institution of Engineering and Technology) Archives, London

Meares, John Willoughby, 'At the Heels of the Mighty: being the Autobiography of "Your obedient humble servant"' (typescript, 1934), Accession Number: SC 169/1/1.

Books, Articles

'Alexander Jardine, DSc', obituary appearing in ICE *Proceedings*, Vol. 48, Issue 4 (April 1971), pp. 723-4.

'Jo Hookm', *The Koochpurwanaypore Swadeshi Railway* (2nd edition, Calcutta, & Simla: Thacker, Spink & Co, and Bombay: Thacker & Co Ltd, [1921]).

Ashby, Lillian (with Roger Whately), *My India: Recollections of Fifty Years* (Boston: Little, Brown and Company, 1937).

Bayley, Victor, *Nine Fifteen From Victoria* (London: Robert Hale & Company, 1937).

Christie, J.M., 'The Manufacture of Oxygen and its Use for Welding and Metal-Cutting', IMechE *Proceedings*, December 1916, pp. 889-894.

Curtis, L. (ed.), *Papers relating to the application of the principle of Dyarchy to the Government of India: To which are appended the Report of the Joint Select Committee and the Government of India Act, 1919, with an Introduction by L. Curtis* (Oxford: Clarendon Press, 1920).

Fermor, L.L., 'Thomas Henry Holland. 1868-1947', *Obituary Notices of Fellows of the Royal Society*, Vol. 6, No. 17 (Nov., 1948), pp. 83-114.

Historical Retrospect of Conditions of Service in the Indian Public Works Department. (All India Service of Engineers), Private pamphlet (c. 1925) in the Secretary of State's Library Pamphlets, Vol. 72, T.724 (APAC: P/T724).

Keenan, John L. [with Lenore Sorsby], *A Steel Man in India* (New York: Duell, Sloan and Pearce, 1943).

Khalidi, Omar (ed.), *Memoirs of Cyril Jones: People, Society and Railways in Hyderabad* (New Delhi: Manohar Publications, 1991).

Kirloskar, S.L., *Cactus & Roses: An Autobiography* (Pune: C.G. Phadke, 1982).

Kunzru, Hirday Nath, *The Public Services in India (Political Pamphlets—II)* (Allahabad: Servants of India Society, 1917).

Institution of Engineers (India): Bye-Laws effective 5 May 2012, http://www.ieindia.info/PDF_Images/Bylaws/ByeLaws.pdf (downloaded 2 July 2012).

Institution of Engineers (India) Yearbook 1964-65 (Calcutta, 1965). British Library Shelfmark: General Reference Collection P. 621/409.

LeMaistre, C., 'Summary of the Work of the British Engineering Standards Association', *Annals of the American Academy of Political and Social Science*, Vol. 82, 'Industries in Readjustment' (March 1919), pp. 247-252.

Leslie, Bradford, 'The Erection of the "Jubilee" Bridge carrying the East Indian Railway across the River Hooghly at Hooghly', *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol. 92, Issue 1888, pp. 73-96 (discussion: pp. 97-128; correspondence: pp. 129-141).

Maclean, C.D., (ed.), *Manual of the Administration of the Madras Presidency: In Illustration of the Records of Government & the Yearly Administration Reports* (reprint, 3 vols., New Delhi: Asian Educational Services, 1987 [1885-93]).

Mahalanobis, P.C., 'Sir Rajendra Nath Mookerjee: First President of the Indian Statistical Institute 1931-1936', *Sankhyā*: *The Indian Journal of Statistics*, Vol. 2, Part 3 (1936), pp. 237-40.

Molesworth, Guilford L., *Indian Railway Policy* (Indian Railway Series No. 1, compiled and edited by Faredun K. Dadachanji) (Bombay: F.K. Dadachanji, 1920).

Natesan, L.A., *State Management & Control of Railways in India: A Study of Railway Finance Rates and Policy during 1920-37* (Calcutta: University of Calcutta, 1946).

Obituary for Sir Robert Swan Highet, CBE, 1859-1934, in *Minutes of the Proceedings of the Institution of Civil Engineers*, Vol. 240, Issue 1935 (1935), p. 787.

Obituary, 'Sir Thomas Guthrie Russell', ICE *Proceedings*, Vol. 31, Issue 1 (May 1965), pp. 126-7.

Reddy, D.V., *Inside Story of the Indian Railways: Startling Revelations of a Retired Executive* (Madras: M. Seshachalam, 1975).

Sahlin, Axel, 'Personal Impressions of India: Written for his friends by Axel Sahlin: January 15th to April 21st, 1908'. Booklet consulted at the Tata Steel Archives, Jamshedpur.

Shah, K.T., *Public Services in India (Congress Golden Jubilee Brochure—7)* (Allahabad: All India Congress Committee, 1935).

Singh, Jagman, *My Tryst with the Projects Bhakra and Beas* (New Delhi: Uppal Publishing House, 1998).

Strong, Joseph F., 'On the Apparatus Used for Sinking Piers for Iron Railway Bridges in India', *Proceedings of the Institution of Mechanical Engineers*, Vol. 14, No. 1 (1863), pp. 16-33 (including discussion).

The Hindusthan Association of America [New York City], *Education in the United States of America: For the Guidance of the Prospective Students from India to the United States, Bulletin No. 1, 2nd and revised edn*. (New York City: Publisher unknown, 1920). British Library Shelfmark: General Reference Collection 8385.a.14.

Journals/Periodicals

Engineer's Journal and Railway, Public Works, and Mining Gazette, of India and the Colonies

Indian Engineering

Indian Railway Gazette

Journal of the Institution of Engineers (India)

Lists of Members, Institutions of Civil/ Mechanical / Electrical Engineers

Minutes of Proceedings of the Punjab PWD [Engineering] Congress

Minutes of the Proceedings of the Institution of Civil Engineers

Minutes of the Proceedings of the Institution of Mechanical Engineers

New York Times

Observer

Railway Gazette

TISCO Annual Reports (Directors' Reports)

TISCO News

TISCO Review

Official Publications[1]

Serials

Hansard House of Commons Debates

Hansard House of Lords Debates

India Office List

PWD Classified List and Distribution Return of Establishment (APAC: IOR/V/13 Series)

Railway Board Reports

Statement Exhibiting the Moral and Material Progress and Condition of India

Thacker's Indian Directory

[1] APAC stands for Asia Pacific and Africa Collections, British Library, London.

Other official publications

'The Indian Industrial Commission: its report summarised', in *East India (Industrial Commission): Report of the Indian Industrial Commission, 1916-18* (Cmd. 51, London: HMSO, 1919), pp. 1-4.

Administration and Progress Report of the Chief Engineer, United Provinces Public Works Department, Buildings and Roads Branch, For the year 1934-35 (Allahabad: Superintendent, Printing and Stationery, United Provinces, 1936), addressed by Chief Engineer Chhuttan Lal, to the Secretary to Government (United Provinces PWD, Roads & Buildings). APAC: IOR/V/24/3304.

Appendix H: 'Scientific and Technical Societies', East India (Industrial Commission), *Report of the Indian Industrial Commission 1916-18* (Cmd. 51, London: HMSO, 1919), pp. 385-7. [IIC Appendix H.]

East India (Civil Services in India). Report of the Royal Commission on the Superior Civil Services in India (Cmd. 2128, London: HMSO, 1924). [Lee Commission Report.]

East India (Constitutional Reforms). Report on Indian Constitutional Reforms (Cd. 9109, London: HMSO, 1918). [Montagu–Chelmsford Report.]

East India (Railway Committee, 1920-21). Report of the Committee appointed by the Secretary of State for India to enquire into the administration and working of Indian Railways (Cmd. 1512, London: HMSO, 1921). [Acworth Committee Report.]

East India (Railways). Report on the Administration and Working of Indian Railways. By Thomas Robertson, C.V.O., Special Commissioner for Indian Railways (Cd. 1713, London: HMSO, 1903).

Extracts from the Debates in the Indian Legislature on Railway Matters: Delhi Session – January-March 1926 (Calcutta: Government of India Central Publication Branch, 1926). APAC: IOR/V/25/720/44.

Extracts from the Debates in the Indian Legislature on Railway Matters, Delhi Session – January to March 1927 (Calcutta: Government of India Central Publication Branch, 1927). APAC: IOR/V/25/720/45.

First report of the Indian Tariff Board regarding the grant of protection to the steel industry (place and publisher illegible: [1924]), via Digital Library of India, www.dli.ernet.in, accessed on 2 Jan 2012.

Government of India Act 1935 (26. Geo. 5. Ch. 2).

Government of India, *A bill to make further provision for the government of India* (1934-5), House of Commons Parliamentary Papers (25 Geo. 5).

Indian Industrial Commission 1916-18, *Report* (Calcutta: Superintendent Government Printing, India, 1918). [IIC Report.]

Indian Industrial Commission, *Minutes of Evidence 1916-17, Volume I: Delhi, United Provinces and Bihar and Orissa* (Calcutta: Superintendent Government Printing, 1917).

Indian Railway Conference Association, *Proceedings of the Conference of Railway Delegates Assembled at Simla, October 1920* (Simla: Government Central Press, 1920). APAC: IOR/V/25/720/42.

Indian Railways Conference Association 1928, *Agenda and Proeedings of The Electrical Section: Meeting No. 1* (place and date of publication not given). British Library shelfmark: W 4026.

Indian Tariff Board, *Evidence recorded during enquiry into the steel industry, Volume I: The Tata Iron and Steel Company* (Calcutta: Superintendent Government Printing, India: 1924). [ITB 1924.]

Indian Tariff Board, *Evidence recorded during enquiry regarding the grant of supplementary protection to the steel industry* (Calcutta: Government of India Central Publication Branch, 1925).

Railway Board, *History of Services of the Officers of the Engineer and State Railway Revenue Establishments, Corrected to 1st July 1910* (Calcutta: Superintendent Government Printing, India, 1910), APAC: IOR/V/12/67.

Report of the Indian Fiscal Commission, 1921-22 (Simla: Superintendent Government Central Press, 1922).

Royal Commission on the Public Services in India. Report of the Commissioners, Vol. I (Cd. 8382, London: HMSO, 1917). [Islington Commission Report.]

The applications received by the Indian Tariff Board from the Tata Iron and Steel Company, Limited, and other companies in connection with the Statutory Enquiry regarding the grant or continuance of protection to the Steel Industry in India after the 31st March 1927, together with the questionnaires issued by the Board and other relevant papers (Calcutta: Government of India Central Publication Branch, 1926). [ITB 1926.]

SECONDARY SOURCES

Books, Articles

'Life and work of Sir Rajendra Nath Mookerjee: The Inaugural-President of The Institution of Engineers (India)' in *The Institution of Engineers (India), Diamond Jubilee 1980: Souvenir* (Calcutta, 1980), pp. 35-37.

'Stewart-Murray, Katharine Marjory, duchess of Atholl', *Concise Dictionary of National Biography*, Oxford University Press, March 1992 (via http://www.knowuk.co.uk, accessed 29 January 2011).

'Turnour, Edward, sixth Earl Winterton and Baron Turnour', *Concise Dictionary of National Biography*, Oxford University Press, March 1992 (via http://www.knowuk.co.uk, accessed 12 June 2012).

Abraham, Itty, *The Making of the Indian Atomic Bomb: Science, Secrecy and the Postcolonial State* (London and New York: Zed, 1998).

Addison, Paul, 'Churchill, Sir Winston Leonard Spencer (1874–1965)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edition, Jan 2011 (http://www.oxforddnb.com/view/article/32413, accessed 8 June 2012).

Anderson, Warwick, 'Introduction: Postcolonial Technoscience', *Social Studies of Science,* Vol. 32, No. 5/6 (Oct – Dec, 2002), pp. 643-658.

Anthony, Frank, *Britain's Betrayal in India: The Story of the Anglo-Indian Community* (Bombay: Allied Publishers, 1969).

Antoniou, Yiannis, Michalis Assimakopoulos and Konstantinos Chatzis, 'The National Identity of Inter-war Greek Engineers: Elitism, Rationalization, Technocracy, and Reactionary Modernism', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 241–261.

Arnold, David, '"An ancient race outworn": Malaria and race in colonial India, 1860-1930' in Waltraud Ernst and Bernard Harris (eds.), *Race, Science and Medicine, 1700-1960* (London and New York: Routledge, 1999), pp. 123-143.

Arnold, David, 'Europe, Technology and Colonialism in the 20th Century', *History and Technology,* Vol. 21, No. 1 (March 2005), pp. 85-106.

Arnold, David, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley, Los Angeles and London: University of California Press, 1993).

Arnold, David, *Science, Technology and Medicine in Colonial India (The New Cambridge History of India* Vol. III.5*)* (Cambridge: Cambridge University Press, 2000).

Baber, Zaheer, 'Colonizing nature: scientific knowledge, colonial power and the incorporation of India into the modern world-system', *British Journal of Sociology,* Vol. 52, Issue 1 (March 2001), pp. 37–58.

Baber, Zaheer, 'Science, Technology and Colonial Power' in S. Irfan Habib and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007), pp. 102-158.

Bagal, Jogesh Chandra, *Pramatha Nath Bose* (New Delhi: Sushama Sen on behalf of P.N. Bose Centenary Committee, 1955).

Bahl, Vinay, *The Making of the Indian Working Class: A Case of the Tata Iron and Steel Company, 1880-1946* (New Delhi, Thousand Oaks and London: Sage, 1995).

Basalla, George, 'The Spread of Western Science', *Science*, New Series, Vol. 156, No. 3775 (5 May 1967), pp. 611-22.

Bassett, Ross, 'MIT-Trained Swadeshis: MIT and Indian Nationalism, 1880–1947', *Osiris,* Vol. 24, No. 1 (2009), pp. 212-230.

Basu, Aparna, 'Technical Education in India, 1854-1921', in Aparna Basu, *Essays in the History of Indian Education* (New Delhi: Concept, 1982), pp. 39-59.

Beaglehole, T.H., 'From Rulers to Servants: The I.C.S. and the British Demission of Power in India', *Modern Asian Studies*, Vol. 11, Issue 2 (1977), pp. 237-255.

Bear, Laura, *Lines of the Nation: Indian Railway Workers, Bureaucracy, and the Intimate Historical Self* (New York: Columbia University Press, 2007).

Black, John, 'The military influence on engineering education in Britain and India, 1848–1906', *The Indian Economic and Social History Review*, 46, 2 (2009), pp. 211–239.

Brassley, Paul, 'The Professionalisation of English Agriculture?', *Rural History*, Vol. 16, Issue 2 (2005), pp. 235-251.

Buchanan, R.A. 'Institutional Proliferation in the British Engineering Profession, 1847-1914', *The Economic History Review*, New Series, Vol. 38, No. 1 (February 1985), pp. 42-60.

Buchanan, R.A., *The Engineers: A History of the Engineering Profession in Britain, 1750-1914* (London: Jessica Kingsley, 1989).

Buettner, Elizabeth, *Empire Families: Britons and Late Imperial India* (Oxford: Oxford University Press, 2004).

Cameron, J.G.P., *A Short History of the Royal Indian Engineering College: Coopers Hill* (n.p.: Coopers Hill Society, private circulation, 1960).

Campion, David A., 'Railway Policing and Security in Colonial India, c. 1860-1930', in Roopa Srinivasan, Manish Tiwari and Sandeep Silas (eds.), *Our Indian Railway: Themes in India's Railway History* (New Delhi: Foundation, 2006), pp. 121-53, esp. p. 147.

Chakrabarti, Pratik, '"Signs of the Times": Medicine and Nationhood in British India', *Osiris*, Vol. 24, No. 1 (2009), pp. 188-211.

Chakrabarti, Pratik, *Western Science in Modern India: Metropolitan Methods, Colonial Practices* (Delhi: Permanent Black, 2004).

Chambers, David Wade, and Richard Gillespie, 'Locality in the History of Science: Colonial Science, Technoscience, and Indigenous Knowledge' in Roy MacLeod (ed.), 'Nature and Empire: Science and the Colonial Enterprise', *Osiris*, 2nd Series, Vol. 15 (2000), pp. 221-240.

Chandavarkar, Rajnarayan, 'Industrialization in India before 1947: Conventional Approaches and Alternative Perspectives', *Modern Asian Studies*, Vol. 19, No. 3 (Special Issue, 1985), pp. 623-668.

Chatterjee, Partha, 'Transferring a Political Theory: Early Nationalist Thought in India', *Economic and Political Weekly*, Vol. 21, No. 3 (18 January 1986), pp. 120-128.

Chatzis, Konstantinos, 'Introduction: The National Identities of Engineers', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 193-6.

Chaudhuri, B.N., M.I.E., 'A short history of the growth and development of the Institution of Engineers (India)' in *Demicenturion* (IEI Commemorative volume [1969]), p. 43ff. Volume consulted at the Library of the IEI, at its Kolkata Headquarters at 8 Gokhale Road.

Dasgupta, Subrata, 'Response to Western Science: Failures and Successes' in S. Irfan Habib and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007), pp. 326-51.

Derbyshire, Ian, 'The Building of India's Railways: The Application of Western Technology in the Colonial Periphery 1850-1920' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995), pp. 177-215.

Dewey, C.J., 'The Education of a Ruling Caste: The Indian Civil Service in the Era of Competitive Examination', *The English Historical Review*, Vol. 88, No. 347 (April 1973), pp. 262-285.

Downey, Gary Lee and Juan C. Lucena, 'Knowledge and Professional Identity in Engineering: Code-Switching and the Metrics of Progress', *History and Technology*, Vol. 20, No. 4 (December 2004), pp. 393–420.

Edgerton, David, 'Innovation, Technology or History: What Is the Historiography of Technology About?', *Technology and Culture*, Vol. 51, No. 3 (July 2010), pp. 680-697.

Edgerton, David, *The Shock of the Old: Technology and Global History since 1900* (London: Profile, 2008 [2006]).

Elwin, Verrier, *The Story of Tata Steel* ([Bombay], n.p.: [1958]) (British Library Shelfmark W 3092).

Ewing, Ann, 'The Indian Civil Service 1919-1924: Service Discontent and the Response in London and in Delhi', *Modern Asian Studies*, Vol. 18, Issue 1 (1984), pp. 33-53.

Gilmartin, David, 'Scientific Empire and Imperial Science: Colonialism and Irrigation Technology in the Indus Basin', *The Journal of Asian Studies*, Vol. 53, No. 4 (November 1994), pp. 1127-49.

Gispen, C.W.R., 'German Engineers and American Social Theory: Historical Perspectives on Professionalization', *Comparative Studies in Society and History,* Vol. 30, No. 3 (July 1988), pp. 550-574.

Gispen, Kees, *New Profession, Old Order: Engineers and German society, 1815-1914* (Cambridge: Cambridge University Press, 1989).

Goldstein, Jan, 'Foucault among the Sociologists: The "Disciplines" and the History of the Professions', *History and Theory*, Vol. 23, No. 2 (May 1984), pp. 170-192.

Goswami, Manu, *Producing India: From Colonial Economy to National Space* (Chicago and London: University of Chicago Press, 2004).

Gupta, Akhil, *Postcolonial Developments: Agriculture in the Making of Modern India* (New Delhi and Oxford: Oxford University Press, 1999).

Habib, S. Irfan and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007).

Habib, S. Irfan and Dhruv Raina, 'Copernicus, Columbus, Colonialism, and the Role of Science in Nineteenth-century India', in S. Irfan Habib and Dhruv Raina (eds.), *Social History of Science in Colonial India* (New Delhi: Oxford University Press, 2007), pp. 229-251.

Harris, F.R. [with Lovat Fraser], *Jamsetji Nusserwanji Tata: A Chronicle of his Life*, 2nd edition (Bombay: Blackie & Son, 1958).

Harrison, Carol E. and Ann Johnson, 'Introduction: Science and National Identity', *Osiris*, Vol. 24, No. 1 (2009), pp. 1-14.

Harrison, Mark, 'Science and the British Empire', *Isis*, Vol. 96, No. 1 (March 2005), pp. 56-63.

Harrison, Mark, *Public Health in British India: Anglo-Indian Preventive Medicine 1859-1914* (Cambridge, New York and Melbourne: Cambridge University Press, 1994).

Headrick, Daniel R., 'The Tools of Imperialism: Technology and the Expansion of European Colonial Empires in the Nineteenth Century', *Journal of Modern History*, Vol. 51, No. 2 (June, 1979), pp. 231-263.

Headrick, Daniel R., *The Tentacles of Progress: Technology Transfer in the Age of Imperialism, 1850-1940* (New York and Oxford: Oxford University Press, 1988).

Huddleston, G., *History of the East Indian Railway* (Calcutta: Thacker, Spink and Co, 1906).

Hurst, H. E., 'MacDonald, Sir Murdoch (1866–1957)', *rev*. Elizabeth Baigent, *Oxford Dictionary of National Biography*, Oxford University Press, 2004 (http://www.oxforddnb.com/view/article/34709, accessed 8 June 2012).

Iftikhar-ul-Awwal, A.Z.M., *The Industrial Development of Bengal: 1900-1939* (Delhi: Vikas Publishing House, 1982).

Inkster, Ian, 'Scientific Enterprise and the Colonial "Model": Observations on Australian Experience in Historical Context', *Social Studies of Science*, Vol. 15, No. 4 (November 1985), pp. 677-704.

Jeffery, Roger, 'Allopathic Medicine in India: A Case of Deprofessionalisation?', *Economic and Political Weekly*, Vol. 13, No. 3 (21 January 1978), pp. 101-103 + 105-113.

Jeffery, Roger, 'Recognizing India's Doctors: The Institutionalization of Medical Dependency, 1918-39', *Modern Asian Studies*, Vol. 13, No. 2 (1979), pp. 301-326.

Kapila, Shruti, 'The Enchantment of Science in India', *Isis*, Vol. 101, No. 1 (March 2010), pp. 120-132.

Kerr, Ian J. (ed.), *27 Down: New Departures in Indian Railway Studies* (New Delhi: Orient Longman, 2007).

Kerr, Ian J. (ed.), *Railways in Modern India* (New Delhi: Oxford University Press, 2001).

Kerr, Ian J., *Building the Railways of the Raj: 1850-1900* (Delhi: Oxford University Press, 1995).

Kerr, Ian J., *Engines of Change: The Railroads That Made India* (Westport, CT and London: Praeger, 2007).

Klingensmith, Daniel, *'One Valley and a Thousand': Dams, Nationalism, and Development* (New Delhi: Oxford University Press, 2007).

Kumar, Arun, 'Colonial Requirements and Engineering Education: The Public Works Department, 1847-1947' in Roy MacLeod and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage Publications, 1995), pp. 216-232.

Kumar, Deepak (ed.), *Science and Empire: Essays in Indian Context (1700-1947)* (Delhi: Anamika Prakashan, 1991).

Kumar, Deepak, 'Racial Discrimination and Science in Nineteenth Century India', *Indian Economic and Social History Review*, 19 (1982), pp. 63-82.

Kumar, Deepak, 'Reconstructing India: Disunity in the Science and Technology for Development Discourse, 1900-1947', *Osiris*, 2nd Series, Vol. 15 (2000), pp. 241-257.

Kumar, Deepak, *Science and the Raj, 1857-1905* (Bombay and Oxford: Oxford University Press, 1995).

Lala, R.M., *For the Love of India: The Life and Times of Jamsetji Tata* (New Delhi: Penguin/Portfolio, 2006 [2004]).

Lala, R.M., *The Creation of Wealth: The Tata Story*, paperback edition (Bombay: IBH, 1981).

Lala, R.M., *The Romance of Tata Steel* (New Delhi: Penguin/Viking, 2007).

Layton, Edwin T., Jr., *The Revolt of the Engineers: Social Responsibility and the American Engineering Profession* (Baltimore: Johns Hopkins University Press, 1986).

Lowe, Rodney, *The Official History of the British Civil Service: Reforming the Civil Service, Volume 1: The Fulton Years, 1966-81* (Abingdon: Routledge, 2011).

Lucena, Juan C., 'De Criollos a Mexicanos: Engineers' Identity and the Construction of Mexico', *History and Technology*, Vol. 23, No. 3 (September 2007), pp. 275-288.

MacLeod, 'Introduction' in Roy MacLeod (ed.), 'Nature and Empire: Science and the Colonial Enterprise', *Osiris*, 2nd Series, Vol. 15 (2000), pp. 1-13.

MacLeod, Roy (ed.), 'Nature and Empire: Science and the Colonial Enterprise', *Osiris*, 2nd Series, Vol. 15 (2000).

MacLeod, Roy M., 'Holland, Sir Thomas Henry (1868–1947)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 (http://www.oxforddnb.com/view/article/33945, accessed 11 June 2012).

MacLeod, Roy, 'On Visiting the "Moving Metropolis": Reflections on the Architecture of Imperial Science' in Nathan Reingold and Marc Rothenberg (eds.), *Scientific Colonialism: A Cross-Cultural Comparison* (Washington, D.C. and London: Smithsonian Institution Press, 1987), pp. 217-249.

MacLeod, Roy, and Deepak Kumar (eds.), *Technology and the Raj: Western Technology and Technical Transfers to India 1700-1947* (New Delhi, Thousand Oaks and London: Sage, 1995).

Mahindra, K.C., *Rajendra Nath Mookerjee: A Personal Study* (Calcutta: Art Press, [1933]).

Meiksins, Peter, 'The "Revolt of the Engineers" Reconsidered', *Technology and Culture*, Vol. 29, No. 2 (April 1988), pp. 219-246.

Metcalf, Barbara D. and Thomas R. Metcalf, *A Concise History of India* (Cambridge and New York: Cambridge University Press, 2003 [2002]).

Millard, J. Rodney, *The Master Spirit of the Age: Canadian Engineers and the Politics of Professionalism* (Toronto: University of Toronto Press, 1988).

Misra, Maria, 'Colonial officers and gentlemen: the British Empire and the globalization of "tradition"', *Journal of Global History*, Vol. 3, Issue 2 (July 2008), pp. 135-161.

Mital, K.V., *History of the Thomason College of Engineering (1847-1949): On which is Founded the University of Roorkee* (Roorkee: University of Roorkee, 1986).

Moon, Suzanne, 'Justice, Geography and Steel: Technology and National Identity in Indonesian Industrialization', *Osiris*, Vol. 24, No. 1 (2009), pp. 253-277.

Moore, R.J., 'The Problem of Freedom with Unity: London's India Policy, 1917-47', in D.A. Low (ed.), *Congress and the Raj: Facets of the Indian Struggle 1917-47*, 2nd edn (New Delhi: Oxford University Press, 2004), pp. 375-403.

Muldoon, Andrew, *Empire, Politics and the Creation of the 1935 India Act: Last Act of the Raj* (Abingdon, Oxon: Ashgate, 2009).

Nanda, Meera, 'The Epistemic Charity of the Social Constructivist Critics of Science and Why the Third World Should Refuse the Offer' in Noretta Koertge (ed.), *A House Built on Sand: Exposing Postmodernist Myths About Science* (New York and Oxford: Oxford University Press, 1998), pp. 286-311.

Nandy, H. (ed.), *IEI marches on* (Kolkata: Cdr. A.K. Poothia for Institution of Engineers (India), 2002 [1996]).

Noble, David F., *America by Design: Science, Technology, and the Rise of Corporate Capitalism* (Oxford: Oxford University Press, 1979).

Nomura, Chikayoshi, 'Selling steel in the 1920s: TISCO in a period of transition', *Indian Economic and Social History Review*, 48, 1 (2011), pp. 83-116.

Oba, Hiruyoki, and Hrushikesh Panda (eds.), *Industrial Development and Technology Absorption in the Indian Steel Industry: Study of TISCO with Reference to Yawata—A Steel Plant of Nippon Steel Corporation in Japan* (Mumbai: Allied Publishers, 2005).

Potter, David C., 'Manpower Shortage and the End of Colonialism: The Case of the Indian Civil Service', *Modern Asian Studies*, Vol. 7, Issue 1 (1973), pp. 47-73.

Potter, David C., *India's Political Administrators 1919-1983* (Oxford: Clarendon, 1986).

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

Raina, Dhruv, *Images and Contexts: The Historiography of Science and Modernity in India* (Delhi and Oxford: Oxford University Press, 2003).

Raina, Dhruv, *Visvesvaraya as Engineer-Sociologist and the Evolution of his Techno-Economic Vision* (Bangalore: National Institute of Advanced Studies, 2001).

Raj, Kapil, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900 (*Basingstoke and New York: Palgrave Macmillan, *2*007).

Ray, Rajat K., *Industrialization in India: Growth and Conflict in the Private Corporate Sector 1914-47* (New Delhi: Oxford University Press, 1982 [1979]).

Riddick, John F., *The History of British India: A Chronology* (Westport, CT: Praeger, 2006).

Rothermund, Dietmar, *An Economic History of India: From Pre-Colonial Times to 1991*, 2nd edn (London: Routledge, 1993).

Roy, Tirthankar, Review of Kapil Raj's *Relocating Modern Science*, in *Journal of Global History*, Vol. 3, Issue 01 (March 2008), pp. 129-131.

Roy, Tirthankar, *The Economic History of India 1857-1947*, 2nd edn (New Delhi: Oxford University Press, 2006).

Sharma, Malti, *Indianization of the Civil Services in British India (1858-1935)* (New Delhi: Manak Publications, 2001).

Shinn, Terry, 'From "corps" to "profession": the emergence and definition of industrial engineering in modern France', in Robert Fox and George Weisz (eds.), *The Organization of Science and Technology in France 1808-1914* (Cambridge: Cambridge University Press, 1980), pp. 183-208.

Shukla, J.D., *Indianisation of All-India Services and its Impact on Administration* (New Delhi: Allied Publishers, 1982).

Sivaramakrishnan, Kavita, 'The Languages of Science, the Vocabulary of Politics: Challenges to Medical Revival in Punjab' in *Social History of Medicine*, Vol. 21, No. 3 (2008), pp. 521–539.

Stein, Burton, *A History of India*, 2nd edn, edited by David Arnold (Oxford: Wiley-Blackwell, 2010).

Tandon, Prakash, *Punjabi Century: 1857-1947* (London: Chatto and Windus; Toronto: Clarke, Irwin and Co, 1961).

Tomlinson, B.R., 'Colonial Firms and the Decline of Colonialism in Eastern India 1914-47', *Modern Asian Studies*, Vol. 15, No. 3 (1981), pp. 455-86.

Tomlinson, B.R., *The Economy of Modern India, 1860-1970* (Cambridge: Cambridge University Press, 1996 [1993]) (*The New Cambridge History of India*, III, 3).

Valderrama, Andrés, Juan Camargo, Idelman Mejía, Antonio Mejía, Ernesto Lleras, and Antonio García, 'Engineering Education and the Identities of Engineers in Colombia, 1887-1972', *Technology and Culture*, Vol. 50 (October 2009), pp. 811-838.

Visvanathan, Shiv, *Organizing for Science: The Making of an Industrial Research Laboratory* (Delhi: Oxford University Press, 1985).

Watson, Garth, *The Civils: the Story of the Institution of Civil Engineers* (London: Thomas Telford, 1988).

Theses / Dissertations

Cuddy, Brendan P., 'The Royal Indian Engineering College, Cooper's Hill, (1871-1906): A case study of State involvement in professional civil engineering education' (PhD thesis, London University, 1980).

Ramnath, Aparajith, 'Breaking free: Technical education policy in India immediately before and after Independence' (M.Sc. dissertation, University of Oxford, 2007).

Sebaly, Kim Patrick, 'The Assistance of Four Nations in the Establishment of the Indian Institutes of Technology, 1945-1970' (PhD thesis, University of Michigan, 1972).

Srinivasa Rao, Y., 'Electrification of Madras Presidency, 1900-1947' (PhD thesis, Indian Institute of Technology Madras, 2007).

WEBSITES

'David Sassoon Library and Reading Room: History', http://www.davidsassoonlibrary.com/history.html (accessed 2 July 2012).

'Engineering Heritage: Past Presidents', http://heritage.imeche.org/Biographies/pastpresidents, accessed 14 April 2012.

'History of C.P.W.D.', at 'Organisation' → 'Historical Background', at http://cpwd.gov.in (accessed 21 July 2012).

'History: Pakistan Engineering Congress an overview of 94 years', http://pecongress.org.pk/history.php, accessed 3 July 2012.

'IMA in Retrospect', at http://www.ima-india.org/IMA_history.html (accessed 12 April 2012).

'Indian Railways: Indian Railway Conference Association: History', http://www.indianrailways.gov.in/railwayboard/uploads/directorate/IRCA/index.jsp, accessed 17 July 2012.

'Sir Bezonji Mehta (1840–1927)', http://www.tatacentralarchives.com/history/biographies/02%20bezonjimehta.htm (accessed 1 July 2012).

'Sir Lakshmi Pati Misra', in 'Luminaries', http://www.iitr.ac.in/institute/pages/Heritage+Luminaries.html (accessed 22 July 2011).

'Vanguards', http://www.tatasteel100.com/people/vanguards.asp (accessed 1 July 2012).

Fenwick, S.C., 'Corps History – Part 10: Indian Sappers (1740-1947)', website of the Royal Engineers Museum, Kent (http://www.remuseum.org.uk/corpshistory/rem_corps_part10.htm, last accessed 4 June 2008) [the source cited for the article by the website is G. Napier, *Follow the Sapper: an illustrated history of the Corps of Royal Engineers* (Chatham: Institution of Royal Engineers, 2005)].

Institute of Technology, Banaras Hindu University, 'Heritage', http://www.itbhu.ac.in/itbhu/heritage.shtml, accessed 9 June 2012.