CHAPTER-3

Industrial Agendas:
Geology and Colonialism

By the end of the nineteenth century, scientific research in colonial India was increasingly coming out of the Asiatic Society and getting organised into government departments. This marked a break from the hitherto amateurish orientation of scientific research as from now on it was sought to be associated more closely with the interests of the state.

The first subject to break away from the Society was geology. In 1839 the government of Bengal had begun a correspondence with Charles Lyell and Roderick Murchison of the Geological Society of London about conducting a Survey to ascertain the Bengal Presidency's coal reserves for use in steamers on the Ganges. After prolonged negotiations, De La Beche recommended D. H. Williams of the British Survey for the post of Geological Surveyor to the East India Company in 1845. Williams spent nearly three years exploring Bengal’s extensive coalfields, and after discovering coal of coking quality, he also evaluated iron, copper and limestone deposits.¹

In 1848, Williams died of fever and three years later the Bengal survey was reborn under Thomas Oldham, former director of the Irish survey. He soon extended its scope to the other two Presidencies including the independent survey commissioned by the Punjab government. A laboratory, museum, expanded staff, and full array of publications followed the surveys. These developments gradually led to the foundation of the Geological Survey of India (GSI) in 1851 to study and map Indian coalfields, the predominant concern of the colonial state, with Oldham as its first director.² Thus Geology in colonial India was now to have a specific function; that of surveying and locating coal and thus serving the interests of the colonial state.

² Ibid.
In meteorology, developments took a different turn. In this field the colonial government was not quick to see the benefits of a meteorological department. It was in fact the Asiatic Society which realised that the description of a uniform system of meteorological observations throughout the sub-continent was beyond its capacity and best suited to the government on the plan of the Meteorological Committee of the Board of Trade in London. The Meteorological Committee of the Asiatic Society, in a letter dated twentieth June 1862 to the government, recommended the formation of a Meteorological Committee under the aegis of the government. However, the recommendations of the Commission of Enquiry into the Orissa and Bengal Famine of 1866 finally convinced the government of the need for an all-India meteorological department. The deliberations took their own time. Finally, in 1875, the India Meteorological Department was formed.

So, it was the mutual realisation of both the government and the Society of the changing perspective and scope of scientific research that led to the formation of these two departments. Such was the case with other sciences as well. The Botanical Survey of India was formed in 1890.

Provision for research in the applied sciences; agriculture, forests, medical and veterinary research came at a later date than the Surveys mostly in the early twentieth century. In agriculture, a provincial department of Land Revenue and Agriculture and of Agriculture was formed towards the end of the century in Bombay (1885), Madras (1889), Shillong (1894), Allahabad and Nagpur (1895) and Bengal (1896). The Indian Agricultural Research Institute at Pusa followed this in 1903. For Veterinary work the Imperial Bacteriological Laboratory was opened at Poona in 1890. It moved to Mukteswar in 1893 and was renamed as the Imperial Institute of Veterinary Research in 1925. The Forest Research Institute at Dehradun was opened in 1906. Medical research was represented by the Central Research Institute founded at Kasauli in 1906 and the All-India Institute of Public Health and Hygiene founded in Calcutta in 1934. Apart from these there were provincially administered medical

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1 Hundred Years of Weather Service (1875-1975), Indian Meteorological Department, Printed by Deputy Director General of Observations (C & G.), Poona, 1975, p. 17.
2 Ibid.

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research institutes, such as the School of Tropical Medicine in Calcutta and the Haffkine Institute in Bombay.  

What prompted this change in government policy was a combination of various factors, not all of which shall be addressed here. To be brief, the main reason was the economic thrust of the colonial state, which sought to exploit India's natural wealth through science. Science by the middle of the nineteenth century was proving to be the ideal tool for the exploitation of natural resources in Europe. This in a colony acquired an added significance; exploitation without development was now the rule. 

What also influenced government policy was the growing popularity of the Utilitarian doctrine among policy makers. The Orientalist attitudes of the Asiatic society had already come under heavy criticism from Macaulay. The amateurish, 'disinterested' nature of its scientific research was considered to be redundant. Science in the utilitarian definition had to be useful, specialised, applied and directly related to the interest of the state. James Mill, in his History of British India advocated the application of western science and technology to the material development of India. Here, Dalhousie, a staunch Tory and a utilitarian administrator played a crucial role. He was instrumental in introducing telegraph and railways in India as well as organising large and important departments, of which GSI was one. So science was now entrusted with new responsibilities in a colonial world - to be applied, practical and closer to the interests of the state. 

The other influence exerted on the colonial government was from the scientific community of Europe, eager to extend the new practical role of science from Europe to the peripheries of the empire. This was most evident in the case of geology- the discipline I intend to focus upon in this chapter. Geology, for its link with minerals - the crucial natural resource in a 'developmental', 'modern', industrial world offered the best possibility of serving the new role of science both in Europe

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and the colonies.

European discourse in geology from the 1830s had started to become increasingly conscious of its mineral potential and attempted to instruct research in the peripheries along similar lines. As Stafford shows, first De La Beche and then Murchison of the Royal Geological Society of London tried to explore mineral possibilities in different colonies. Murchison’s overseas geographical activities fell into two categories; one exemplifying the minerals of the empire, the other explored mineral opportunities in the larger area beyond colonial territories. He ‘bombarded’ colonial secretaries, viceroys and governors with advice that geologists be installed in every province and dependency. He was instrumental in the formation of the GSI, the Geological Survey in Trinidad, British Guyana, Tasmania and New Zealand as well as outside the empire in Turkey, Palestine, Brazil outside the Empire. Murchison also gave a new meaning to geology in associating it firmly with military expeditions particularly in the colonies.  

Thus, the attempt was re-organise science into governmental surveys on the patterns of European surveys as a part of which operation the GSI was formed. The formation of the GSI was influenced by the intellectual, colonial, Centralist factors. Regarding the impact of European ideas, Robert A. Stafford’s works on De La Beche and particularly Murchison provide the basic framework for understanding these developments. Stafford sees the metropolitan geologists playing a ‘sub-imperialist’ role in their efforts to extend mineralogical research to the colonies, through their “desire for new data, new careers, new satisfactory conquests, a new voice in administrative affairs - meshing with the needs of the imperial government”. He argues that Murchison was a crucial exponent of nineteenth century British imperialism, combining Gramsci’s notion of hegemony, Shapin’s emphasis on multifunctionality in the geology of scientific knowledge and Cain and Hopkin's

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11 Ibid., p. 23.
thesis of "gentlemanly capitalism".12

Deepak Kumar suggested that the thrust of 'colonial geology' remained the imperialist exploitation of India's mineral wealth.13 To that extent, he extended Stafford's thesis to South Asia in so far that he emphasised the role geology played in colonial India to sustain and nourish the Empire. His work is important in locating science in the colonial political economy of nineteenth century India.

However, in such narratives the story of the geologists working in India in the late nineteenth early twentieth centuries and their science remains untold. How did the latter react to the organisational changes of the period? How did these shifts affect their perceptions of geology? To what extent did geologists change the nature of their discipline to bring it in line with the demand of industry? How did they respond to the demands of the colonial government now that they served it directly? How did geology's European links with mineral and industrial development respond to the colonial context? Finally, did these trends herald the end of Orientalist romanticism in the discourse of science in colonial India?

My concerns in this chapter shall revolve around these questions. I will try to see how scientists and science reacted to changing times in new institutions. What new visions developed the nature of commitment shown and initiatives taken? I show that the discourse revolved around three contesting points, between applied and pure research, industrialism and romanticism, colonialism and universality.

These changing attitudes will be studied in the context of the changes in Indian, British and international economic trends and the relationship of the same with the shifting hierarchy of imperial interests and the growing constraints on the governments in London and Delhi. The introduction and expansion of railways in India, the growing imbalances of payment of England with other industrialised countries, the First World War and linkages whether scientific research and industrialisation in the west will also be discussed.

12 Stafford, Scientist of Empire, pp. 203, 206.
This period was also marked by the rise of nationalism in India. This gave a new orientation to the questions of science and industrialism, discussed in another section. My concern here will be the European scientists working in India, who remained unaffected by nationalism and Swadeshi. This approach will help, I believe, to bring out the significant links in the two seemingly different approaches.

**The Early Years**

Coal was Britain's passport to prosperity and as Murchison pointed out, was the “meter of power of modern nations”.\(^{14}\) Thus, the focus of GSI from the beginning was on coal. Under Oldham, Medlicott and Blanford, the GSI in the initial years compiled a vast record on coal and other Indian minerals. *The Memoirs of the Geological survey of India*, published in 1856 and the *Records of GSI*, started in 1868, regularly carried information about mineral resources, particularly coal, in different parts of the country. In addition, a *Manual of Geology of India* in two volumes by Medlicott and Blanford were published in 1879, to which was added a volume on Economic Geology by Valentine Ball and another on mineralogy by F.R. Mallet in 1881.\(^{15}\)

However, the GSI suffered from early setbacks. As a result of the great revolution revolt, very little work was done between 1857-58.\(^{16}\) A number of officers (assistants) joined its tasks in 1857, W. K. Loftus joined in February, while Walter Lindsay Wilson, senior geologist of the Geological Survey of Ireland, joined in March, J. Greoghagan joined in April and H. Child in June. Subsequently the department was upgraded after the administration of India was taken over by the Crown. Problems began in 1858. Greoghagan died of sunstroke in May. Child died of cholera in June, Loftus was sent home in November, but died soon after his arrival in July 1859 of a liver infection. Until 1876, when Oldham retired the GSI, due to heavy casualties, had constantly to find new officers.\(^{17}\) Further, Oldham had to build


\(^{16}\) Fox, *op. cit.*, p. 21.

\(^{17}\) *Ibid.*
the department from scratch. Oldham felt hampered because it was almost impossible to recruit geologists in India as the subject was not taught in the country.

Moreover, it was soon realised that the quality of Indian coal was not very high, as its high content of ash and little carbon made it inferior to its English counterpart. Oldham regretted that little remained of the hopes that "coal fields of India, Burma, Australia and New Zealand will not alone yield ample supplies but will also serve to coal the ocean steamers trading and likely to trade between Europe and those far distant regions". Valentine Ball surveying the Raniganj coal fields commented, "compared with ordinary English coal, the Raniganj coals, and India generally, are very much inferior in working power." Neither was news from other parts of the empire very encouraging. Success eluded geologists in New South Wales, Tasmania and South Africa. These early disappointments and Murchison's death in 1871 marked a lull in geological activities in England as well as in the colonies.

However, the greatest problem faced by geologists in India was their inability to define a clear role for themselves in the early years. On the one hand they had a difficult heritage to deal with; that of the Asiatic Society. The earlier fascination for Indian nature, for solving puzzles and non-utilitarian scientific research dominated their attitudes. Betraying the colonial devotion to coal, the geologists of GSI continued to devote much of their time to the study of the general geological structures and physical features of the sub-continent. Till the end of the nineteenth century more than half of their publication were concerned with such questions. The GSI, in much the same manner as the Asiatic Society was interested in building

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19 Deepak Kumar makes this point. See Kumar, "Science, Resources and the Raj", op. cit., p.87.
20 Ibid., p. 73.
24 Ibid.
25 As per Statistics provided by Kumar, out of 82 parts of Memoirs of Geological Survey of India, from 1856 to 1901, not less than 40 were denoted to the study of geological and physical features of several areas of the country. See, Kumar, "Science, Resources..." op. cit., p. 85.
up links with various scientific and geological societies and organisations throughout the globe and its publications were found in various libraries world wide.\textsuperscript{26}

To V. Ball, actively surveying the coal fields of Chotanagpur in 1880 the real attraction of geology in India remained the fact that, "...there is a great, of indescribable pleasure in being the first to take up the geological exploration of a hitherto quite unknown tract - in being the first to interpret the past history of a portion of the earth's crust which no geologist has ever seen before..."\textsuperscript{27}

The respect for an amateurish scientific research preferred by the Asiatic Society could be seen in Blanford's insistence, while organising the Meteorological Department, that such studies should be part of its work. He said,

...There are some kinds of special enquiry which can hardly be treated as matters of \textit{routine}, and which requires more knowledge and judgement than can fairly be expected from these persons who are interested with the registration of meteorological observations merely as a subordinate part of their official duties.\textsuperscript{28} (Emphasis mine).

Therefore, official scientific works was seen as 'routine', a 'duty', divorced from questions of "knowledge and judgement", associated with the earlier period. Blanford ended his book by paying a rich tribute to the early 'pioneers' and expressed a hope that his department would continue to emulate their spirit.\textsuperscript{29} Similarly Medlicott while discussing the Himalayan glaciers in 1877, urged the residents of the Kangra Valley to study the former rather than concentrate on the cultivation of tea.\textsuperscript{30} This remark indicates that science in the early years was yet to come to terms with colonial economic obligations. Scientists were suspicious of the commercial preoccupations in the colonies, which they thought would marginalise scientific research.

\textsuperscript{26} \textit{Ibid}, p. 88.
\textsuperscript{27} Ball, \textit{op. cit.}, p. X
\textsuperscript{28} H. F. Blanford, \textit{Meteorology of India; being the second part of the Indian Meteorologist's Vade Mecum}, Office of Supt. of Govt. Printing, 1877, p.165.
\textsuperscript{29} \textit{Ibid}.
One outcome of these developments was the preoccupation of the GSI with the preparation of maps pointing out the general features of the sub-continent, often at the cost of research on minerals. To Cyril Fox, a geologist of later years, the early failures of the GSI were precisely these:

It is true that the preparation of geological map by fieldwork is as important as the making of plans and section by a civil or a mechanical engineer, but there still remained the practical development or erection to be carried out if the surveys were made with any seriousness... The GSI was definitely begun in 1846 to give assistance to the coal mining industry of that day...\(^\text{31}\)

But instead of doing that, he felt that the GSI,

...was obliged to concentrate on the preparation of the geological map of India. Whether this was due to lack of personnel or the belief that India was not endowed with economic minerals is hard to say. The fact remains that mineral development was left largely to private enterprise, which concentrated mainly on rich occurrences of ore, and minerals whose exploitation for export or other use required little risk and practically no capital.\(^\text{32}\)

It was because of this early failure that the GSI, Fox felt, could never become an active mining agency like the Bureau of Mines of the United States or Canada.

The inability of the GSI to define a clear role for itself was also due to the absolute domination by European interests of colonial mineral research in the days of Murchison. Murchison's immense personal calibre, authority and enthusiasm for mineral research in the 'periphery' meant that geologists in the colonies were overshadowed and suffered from a lack of initiative and motivation for independent mineral research. For one, their instructions were strictly to locate coal alone. Geologists in India were asked to play the limited role of prospectors of coal, without being involved in and deliberating on industrialisation and economic growth. The


realities of scientific research in the colonies were very different from that in contemporary Europe, particularly geology as marked from the days of De La Beche.

However, the colonial government itself was yet to fully recognise the value of geology during the early years and was happy to focus on coal. This is not very surprising because even the English political interests had little clue of colonial mineral resources. As Stafford pointed out, Murchison was ahead of his time and realisation of the potentialities of his project dawned in the closing years of the nineteenth century.33

Initially, the colonial state was not interested in securing or regulating mineral rights. This made the business of mineral procurement very difficult for miners. Ball, quoting Mr. Laing who came from Australia to locate gold in India, felt that “India can never be like Australia because there are no miners’ rights”.34 Ball showed that in numerous cases enormous sums of money had to be paid to landholders on whose land the mine was located, which made mining of the minerals unprofitable. He gave the example of a gold mine in Bhagalpur, for where the landholder was offered 50 lakhs of rupees, but who demanded 50% of the profits. As a result the mine was never worked.35

The outcome of such a situation was that the geologists had little motivation to take interest in the mining of minerals once they were located. This problem was pointed out later by J.A Dunn, director of GSI in the 1930s. He said,

In the past, the Geological Survey was never regarded as an active mining body; once a mineral deposit was located and information concerning it collected, the Department’s function normally stopped at that point, and it was left for others to prospect further and to develop. Hence, till someone

34 Ball, op. cit., p. 342.
35 Ibid., p. 343. Ball mentioned another common problem that the geologists and miners faced in India, that of legal harassment by local people on trivial issues. Himself a sufferer of such cases, an exasperated Ball added, “The manager of a mine or factory should combine the qualification of a lawyer- and a very sharp lawyer-with a knowledge of his own particular business, and, as a matter of experience it will be found that more than a moiety of his time will be devoted to the former branch of his business”, p. 344.
was willing to accept the risk, nothing further could be done.  

Under such conditions of confusion, the domination of metropolitan interests, the limited scope, overwhelming traditions of the past, adjusting to the routine of a government job and little connection with questions of mining and development, the life of a geologist in the colonies was the story of dilemmas. The lack of respect for their position as geologists added to their problems.

Medlicott gave a hint of the pressures faced by a geologist, when he said,

...The geologist has an anxious part to play with reference to practical questions. He is instituted more as a concession to what seems but a rising fashion, than from any faith in his knowledge or any understanding of his function; and thus it happens that he is not consulted when his opinion might be of great service, or, on the other hand, he is called into perform what is quite out of his line of business, or twitted for not having done what it would be unwise to attempt unless under special circumstances, and impossible to undertake without special appliances that were not at his disposal.

Geologists saw themselves as misunderstood and unsupported, the sole believers in their cause.

And (when) no one is more aware than himself that the best if not the only, warrant for his existence is his usefulness, such circumstances are very distressing. The Martyr’s hope is sometimes his only consolation— that there is surely a better time about to dawn, when knowledge will prevail among the people. (Emphasis mine)

Geologists saw themselves as victims of their surroundings, destined for something far nobler than what they were doing. Somewhere in these words we hear the resonance of the tragic quest of the previous chapter. Scientists still felt that they

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17 Quoted in Fox, “Presidential Address,” *op. cit.*, p. 25.
were misfits, victims of circumstance in a strange world.

But the story narrated in this chapter is not about a tragedy. It is about breaking new ground, adding new dimensions to the discourse of science and creating new possibilities and hope for scientists in the colonies. The man who was responsible for providing a new direction to scientific discourse in colonial India was the geologist Thomas Holland. Holland played a dual role- as a scientist in the periphery and a scientist-statesman in the Centre, which makes him an interesting person to study. For this reason a considerable part of this chapter will focus on him.

Holland’s activities have to be located within the changing nature of the colonial Indian economy and contemporary government policy. Holland’s emergence in the Indian geological scene coincided with what is known as the “New Industrial Policy” of the Government of India during 1900-1920. Viceroy Curzon in this regard played an important role.

According to Curzon’s conception of the state the government associated itself actively in encouraging enterprise. He rejected laissez faire policies publicly, for which he faced strong opposition from Victorian entrepreneurs like Sir James Mackay. The Simla Education Conference organised by Curzon to reform the Indian education system exposed the divorce between industry and the government’s technical institutions. The demand for commercial information among the business community was increasing to cater to which a new Department of Industry and Provincial Industries was created. This department, according to Curzon, was to provide crucial ‘industrial advice’.

Another crucial factor which helped in the shift in policy and threw up men like Holland and Chatterton was what Dewey calls the ‘inherent momentum of the bureaucracy itself’. In the hierarchical administrative structures of colonial India, bureaucrats enjoyed a lot of freedom in administrative initiative. The top echelons of

40 Ibid., pp. 223-224.
41 Ibid., pp.219-222.
42 Ibid., p.218.
the Indian bureaucracy, freed from routine of day-to-day decision making, were supposed to continuously review the working of the entire state apparatus. This naturally gave them a good grasp over the defects in the administration and the chance to push through workable reforms. This, coupled with the general paternalism of a colonial bureaucracy, inspired a creative spirit among these men whenever the colonial states indicated its keenness, during the period of Curzon and the First World War.

**Thomas Holland and Indian Geology**

Holland was born on November 22nd 1868, at Helston in Cornwall. When he was 16 he won a national scholarship to the Royal College of Science, where he won a First Class Associateship in Geology with honours, in 1888, also winning the Murchison Medal and Prize. After a period at South Kensington as assistant to Professor Judd he gained a Berkeley Fellowship to Owens College, Manchester in 1889. In 1890 at the age of 21, he was appointed an Assistant Superintendent in the GSI. After he reached Calcutta on October 1890, he was made Curator of the Geological Museum Laboratory. In addition, he became the first ever lecturer in Geology at Presidency College. It is in this position that we see the first glimpse of his organisational capacity, foresight and enterprise. There being no previous Professorship in Geology at Calcutta, he organised courses in geology and securely established the custom that prevailed for many years by which the curator of the GSI usually lectured at the Presidency College. And in his capacity as a Curator, Holland effected many improvements in the arrangements of the mineral gallery of the museum, continuing the work began by F.R Mallet. In particular he assembled and organised a collection of the pre-Cambrian formation of India.43

Although stationed in Calcutta, he made repeated excursions to the nearby mine fields and was also available to the Director for emergency enquiries as and when required. He not only acquainted himself with Indian geology and minerals but also established a reputation as a petrographer, as one interested in the economic side

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of geology, and as a man of enthusiasm with organisational skills.\(^{44}\)

All these developments were not lost on the colonial state, which during the end of the nineteenth century was increasingly becoming aware of the greater possibilities of mineral in the imperial scheme. It also felt that the GSI was paying too much attention to the theoretical side of geology and enough to its practical side.\(^{45}\) As a consequence, in February 1903, Holland was appointed Director of GSI, at the young age of 36, succeeding C.L. Greisbach. His appointment was sudden, unexpected and shocked a few.\(^{46}\) But Holland soon assumed full control of the GSI.

Holland’s contribution to colonial Indian geology may be located at three levels. Firstly in his attempt to re-define the role of science in general and geology in particular in this country and to bring a practical orientation to scientific research; Secondly, his organisational changes to geological research in this country to fit this new orientation. Thirdly and extremely significant was his attempt to link scientific research and industrialism.

Re-Defining Science

By becoming the Director of the GSI during a crucial period of Curzon’s industrial policy, Holland was favourably placed to urge changes in scientific attitudes. He was quick to grasp that if scientific knowledge of this country was to be made useful it had to move beyond the confines of the amateur knowledge based pursuit which typified the work of the Asiatic Society. Without this shift, the question of the application of science would always remains problematic, no matter how many surveys of economic value were undertaken. To bring about a decisive break in that tradition, he emphatically stated, “the great end of life is not knowledge but action”.\(^{47}\)

Holland stressed that the logic of science had changed and marked the beginning of a new discourse. It also marked the beginning of a contest between pure

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\(^{44}\) Ibid. p. 233.

\(^{45}\) Ibid.

\(^{46}\) Among those superseded in this appointment were, C. S. Middlemiss and T.D. La Touch, See Ibid; and also P. N. Bose, see A. K. Ghosh, “A Short History of the Geological Survey of India”, Science and Culture Vol. XI, No. 7, Jan 1946, p. 332.
and utilitarian research. He simultaneously showed that the existing problems of the GSI were due to an earlier brand of logic. That is why it was losing its main focus, which was, “developing our mineral resources”.

Holland also noted that most problems were caused by the scientific approach in colonial India, which was yet come to terms with applied science. To Holland the problem started with the very definition of a ‘scientist’:

We have developed a habit of calling a man scientific when the material he handles are microscopic sections, fossils, stars, deep-sea fishes or germs, the less marketable his product the more scientific is the worker in the popular estimation. As a consequence of general unfamiliarity with the materials with which the so-called scientist deals, he has been alternately looked upon as a harmless lunatic or treated as a jogi because of his desire to know things that are of no apparent practical value...

It all started with the way science was taught in England, particularly by professors who had abhorrence towards business and industry related matters.

...The boy who goes out of the public school seldom sees any connection between the science he is taught and the profession to which he is subsequently apprenticed, because the Science Master has, as a rule, no practical acquaintance with the industrial aspects of the science he teaches, being generally more in touch with the professor of the so-called sister sciences than with the captains of industry...

For Holland, science needed to be applied and its links with industry had to be based on mutual benefit. He argued that “obviously, the interests of science and industry are bound together; each advance of science is followed by new development of industry, and, at the same time, industrial progress facilitates in

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47 lid id p. 11.
50 Ibid.
51 Ibid.
endless ways the means for scientific research."\(^{52}\)

The greatest achievements of science, for him, were, "...the safety lamp, the steam-engine, and the electric telegraph rather than the atomic theory, the quantitative law of electrolysis and the mechanical equivalent of heat."\(^{51}\)

If science had to re-define its purpose, if the application of knowledge had to become the ultimate logic, then scientists had to discard their indifference towards business and industry. Holland wanted scientists to start working together with men from practical fields and to accept them as their professional 'brethren'.

...The grouping together of those engaged in the problems of theoretical so-called scientific, value with those engaged in the practical application of the same science, is a more natural form of classification than the grouping together of representatives of the various pure science, and the separation from technical and business men.\(^ {54}\) (Emphasis mine)

Coming back to geology, he felt the urgent need for it to involve itself with practical questions at a very different level. It had to cease to be a pure science; geologists had to start working with mineralogists and industrialists. It was only then that the theoretical knowledge of geology would be put to real test and that it could prove the logic of its existence and we infused with new meaning. He suggested that "...representing the class of members whose practice is what most of you would call theoretical, I welcome the opportunity of having my theories tested by the fire-assay of financial result."\(^ {55}\)

In doing so, he saw himself as a pioneer in colonial India, a scientist who was waking up to the realities of practical life and putting an end to the practices of the past. With an acute awareness that he was playing a historic role, he said, "I am thus in the position of the early riser who has passed noon day - I have lost my conceit, and wish to be saved from the afternoon of stupidities...."\(^ {56}\) (Emphasis mine).

\(^{52}\) Ibid., p.13.
\(^{53}\) Ibid.
\(^{54}\) Ibid., p. 14.
\(^{55}\) Ibid., “Presidential Address”, 1907, op. cit., p. 32.
\(^{56}\) Ibid.
A believer in 'action', Holland associated himself with mining engineers who he believed were an inseparable part of geological activities. His famous collaboration with W.N. Pickering (a mining engineer) saw the formation of the Mineralogical and Geological Institute of India (MGII), 1906, formed to encourage the interaction of geologists with mining engineers, industrialists and government representatives. Having said this it must be pointed out that earlier attempts had been made to infuse industrial and business ethics with mineral research. In 1883, in a series of four popular lectures at the Sassoon Mechanic's Institute, Bombay A.N. Pearson (the Royal examiner of geology and mining at the University of Bombay) aimed to cater to these sectors saying, "...I shall endeavour to put myself in the position of a capitalist who is desirous of devoting some of his capital to the development of the mineral resources of India." It was from this position that the geologist discussed questions of profitable development of minerals, how capitalists should carry out their project, where they should seek advice and how the enterprise should be managed. Pearson was a precursor to Holland also in stressing the importance of minerals as the new economic force. He argued that with railways using local steel and the changing attitude of the colonial state towards industry, "There is generally in these days a turning of attention towards the potential wealth of India, and an evident willingness to see what can be done towards its development;" He urged that the time had come to make a break with the past. New forms of industries using mineral resources must replace the old ones. India had to follow the global pattern of industrial logic,

India is not isolated, either by natural barriers or artificial protections; and therefore in dealing with the subject of the development of its mineral resources we have not so much to consider the revival in their original form of old industries, as the introduction of such new ones and the remodelling of such old ones as can be profitably worked under the influence of foreign competition.  

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57 The development of the Mineral Resources of India Education Society Press, Byculla, Bombay 1883, p.2.
58 Ibid.
60 Ibid., p.7.
Pearson’s lectures covered the various minerals that India possessed, their commercial viability, and the mining techniques necessary to extract them and their future use. Another early work was of course George Watt’s *Dictionary of Economic Products of India* (1889) which was compiled with two purposes in mind; on the one hand to supply scientific information which could be useful to administrative officers and to meet the requirements of business in search of definite information regarding Indian economies on the other.\(^6^0\) Holland added to the category of most essential minerals chosen by Watt salt, coal, iron-ore and petroleum. His additions included gold, graphite, jadeite, magnetite, manganese, mica, rubies, salt-petre and tin.\(^6^1\) What particularly distinguished Holland from all earlier efforts was his emergence during Curzon’s policy changes which allowed him many organisational freedom. Added to that was his successful mineral campaign at the international level. Once he went back to Europe after his retirement from the GSI in 1909, he kept his interest in Indian minerals alive. He published his political and economic views on Indian resources in “The Trends of Mineral Development in India” (1911).\(^6^2\) In Europe Holland expanded his interest on minerals. He developed a great interest in the impact of the economic of mineral deposits upon national and international affairs. The years between the First and the Second World Wars saw Holland very active in this regard. In a paper read in 1927 at Montreal, Canada, at the Second Empire Mining and Metallurgical Congress, Holland advocated the necessity of a review of the mineral resources of the British Commonwealth. The information made available, he believed, regarding the surpluses of mineral supplies in certain parts of the Commonwealth, to help meet deficiencies in other parts and to accumulate data for the formulation of an economic policy for the mineral industry. This paper had already been submitted in draft form and discussed at a meeting of the Institution of Mining and Metallurgy in London earlier in the same year. After another discussion in Ottawa, a resolution, sponsored by R. E. Palmer, President of the Institution of Mining and Metallurgy, was passed by the Empire Congress referring Holland’s proposal to the Empire Council of Mining and Metallurgical.

\(^6^0\) George Watt, “A Dictionary of the Economic Products of India Vol. 1, 1889, p. VII.

\(^6^1\) Holland “Mineral Production, 1898-1903”, Records, Vol. XXXII, part 1, 1905, p. 3.

Institution for consideration by their constituent bodies. In his Presidential Address to the British Association at Johannesburg in 1929, Holland in a paper entitled “The International Relationship of Minerals” in the course of which he developed the thesis that owing to their control over a very considerable proportion of the total mineral research of the world, the British Empire and the United States could, by refusing to export minerals to belligerent countries, prevent wars of long duration. Holland, therefore, regarded this proposal for a review of Empire mineral resources necessary to “facilitate a working agreement between the two great mineral powers that alone have the avowed desire and the ability to ensure the peace of the world”.63

Holland’s writings were summarised in a book called, The Mineral Sanction as an Aid to International Security (1935) in which he showed that before 1914, if the British Commonwealth, the United States and Russia had adopted a common policy on the export of minerals for the use of munitions to potentially aggressive countries such as Germany and Japan, the outbreak of the War could have been prevented.64 He also argued that the Article XVI of the League of Nations Charter had proved unworkable. It was suggested that an agreement among nations refusing to supply war minerals to aggressors would provide a practicable and suitable means of restraining industrialised powers wishing to resort to war.65

In 1942, during the Second World War, Holland reasserted the same points in his paper on the “Relation of Mineral Resources to world Peace”, at the Conference on Mineral Resources and the Atlantic Charter on July 25.66 During the same conference the famous geographer L. Dudley Stamp read the paper “The Exploitation of Minerals in Relation to National and World Planning” in which he discussed how minerals deserved special attention in planned economics because they could not be replenished, unlike plant and animal products.67

Holland was also interested in the question of oil. In India he acted as the President of the Burma Oil Reserves Committee. In England he was a member of the Royal Commission on Navy Fuels between 1911-1913. In 1928 he visited Trinidad and advised the Colonial Office on ways of promoting the maximum and most efficient exploitation of the island’s oil reserves. He was for many years a geological consultant to the Burma Oil Company and for nearly 12 years a member of the geological advisory panel of the Anglo-Iranian Oil Company.68

Organisational Reforms - I

The first steps taken by Holland after becoming the Director of GSI was to secure from the Government of India an increase of staff and better terms of pay. He directed his officers to make comprehensive studies of particular minerals such as coal, manganese ore and petroleum.69 He set the trend for such studies by his own examinations of mica deposits in India and his report on iron ores and iron industries in the Salem District.70 He impressed upon his staff his conception of GSI as an intelligence department upon which the miner based his plans of campaigns and expanded the work of the department in the domain of mineralogy.71

Holland transferred from the Revenue and Agricultural Department to the GSI the collection and collation of the statistics of Indian mineral production, in the annual reviews published in the revised Records of the GSI. Further he instituted the well-known Quinquennial Review of mineral production. The first issue covered a six-year period from 1898-1903. These reports were not mere assemblage of annual figures, but also contained geological and economic data concerning each mineral. This was a special feature of GSI reports that until 1933 had no parallel amongst publications of any other geological survey in the world.72

68 “Holland”, p. 237.
69 Ibid., p. 233.
72 “Sir Thomas Henry Holland”, p. 234.
Holland revised the rules of the existing mineral concessions of the country so that the GSI could play a more important role there. The government by 1899 had already changed the mining rules, which had created so much trouble earlier. Holland also acted as the president of the Burma Oil Reserves Committee, which drew up rules for the regulation of the Burma oil fields with the object of preventing their wasteful competitive exploration by rival companies. By early 1900, a number of small British companies had been attracted to the Burma oil field by its high profits and started extracting oil, as a result of which yields began to fall.

Holland was extremely dissatisfied by the way in which the GSI had approached the mineral question in previous years. He criticised his predecessors for having failed to initiate a discourse on mineral which according to him, was the basic function of the GSI. He ridiculed the existing amateurish conception of the GSI of geological research as an exercise of 'pure' science in strong words.

...the government have not maintained a geological survey for the last 55 years merely to know Jurassic fossils occur in Central Himalayas, or that the trap intrusion which have been such a pest in the coal fields are peridotites instead of lamprophryses, as they were once thought to be. The object in view is the development of the mineral resources of the country, and whatever my scientific friends may say, it is the duty of the government and the duties of their scientific officers to make this the paramount object of scientific work in India.

The work of the department was now defined in clear terms. Science could no more be leisurely pursuits, but it had to rigorously engage with definite practical objectives and responsibilities. Scientists had to produce economic results and be focused to that end. To that extent, according to Holland, responsibilities rested with the Director, "...the Director of Geological Survey has no more right to...

\footnotesize{71} Holland, p. 234.
\footnotesize{75} "Holland", p. 234.
utilise his position for any scientific hobby of his own than a sporting revenue officer has a right to spend the collected taxes on race-horses". 78

What Holland wanted to bring about in the activities of the department was a different ethic of research, a certain sense of urgency, responsibility and accountability. Starting from the Director, everyone was to be tightly bound by these conditions of work. He asserted that, "...whether, therefore, we like it or not the official geologist in this country is bound by the terms of his appointment to remember, that, either directly or indirectly his work should aim in the long-run at the development of our mineral resources...". 79

One of the ways in which Holland sought to bring about a change in the existing leisurely approach was by securing strong links with the state. He transferred the duty of advising the central and provincial governments in British India about the grants of mineral concessions to the GSI. 80

Challenging the predominant irreverence of the geologists of the GSI towards 'mere prospectors', he sought to redefine its status by making it both a scientific and a prospecting body. He observed that in general the fieldwork of the GSI ended with the survey of minerals of economic value and did not include the prospecting. Its responsibility ended with the publication of the information available at that stage. But in his vision the GSI had more to do. It was to take a direct interest in the work of prospecting and exploiting the minerals necessary, the condition under which concessions were granted to the miners. It was also to summarise the statistics of production and to point out the steps to be taken subsequently. He started publishing a summary statement of the previous year's mineral production and a list of the concessions granted in the areas within which the government owned a right to mine every year in the Records. 81

Under his direction, the GSI took certain initiatives in this regard. In the specific case of aluminium, the GSI had established the existence of large quantities

77 Holland, "Presidential Address", 1907, p. 32.
78 Holland, "Presidential Address", 1908, p. 14
79 Ibid.
80 "Holland", p. 234.
of bauxite in India a mineral from which aluminium could be extracted. For some time the GSI was compelled to discount the value of this discovery on account of advice from experts to the effect that pure aluminium oxide could not be prepared on a large scale in a form suitable for transport given the heavy export charges. On a trip to England, Holland found that the previous information was wrong. Pure oxide could be calcined and reduced to a form, which would permit long distance transportation in ordinary sacks as was the practice in Europe and America. It was then that GSI encouraged enterprises to produce calcined oxide from Indian bauxite.\textsuperscript{82} He expected the GSI to take an active interest into the question of mining also. This meant the GSI had to break new grounds to make itself effective and profitable.

...Although a Geological Survey has nothing to do with the actual work of mining, it is necessary for it to maintain an intelligence branch capable of making a general statistical survey of the industry; for the economic minerals of value of are place may have no value in another, and their values in the same place naturally with changes in the markets and developments in the means of transport. To direct our researches into the most profitable channels, therefore, it is necessary for the geologist to keep in touch with the mining industries...\textsuperscript{83}

So in Holland we see all the qualities, which in Stafford’s opinion exemplifies “the sub-imperialism of scientists”. In the discourse on mineral and stronger links with government he was carrying forward Murchison’s projects on the development of colonial mineral resources. His reorganisation of GSI was in confirmation with colonial designs. In later years he participated in the European mainstream discourse on minerals.

He too, like Murchison before him, believed that minerals, were “the meters of the power of moderns nations”. Moreover his stress on applied research was somewhere in accordance with the Centralist view that India should leave pure science to Britain and concentrate on to the applications of science for colonial

\textsuperscript{81} Holland, “Presidential Address”, 1908, p. 16.
\textsuperscript{82} \textit{Ibid.}, pp. 32-33.
Holland, however, had contradictions in his thought, which makes it difficult to fit him into the Centralist imperial scientific discourse. Holland played a dual role, one that of a peripheral scientist working in colonial India and the other of a statesman of the Centre. Often we see in him the two facets mixed up in a peculiar way. This led to interesting developments, some of which are studied below.

**Between Centre and Periphery**

We have already seen how Holland contributed to the international discourse on minerals. In general, he had an eminently successful career in Europe and other parts of the world, where he held important positions and gave prominent leadership to various projects. His colonial bureaucratic career had provided Holland enough space to develop and initiate his own theories on minerals and growth. From the days of Murchison itself, minerals had become a major interest of discussion in colonial geology. Holland's organisational and leadership qualities helped a greater extension of such involvement. The success of his agenda of minerals in Europe was also linked with certain developments taking place there. The second wave of industrialisation, which had marked Europe in the second half of nineteenth century, had enhanced its mastery over mineral resources. The newly emerging industrial nations like Germany and United States had developed new methods of electrification, steel production and machine tools much before the First World War. Thus, by the early years of the twentieth century, the exploitation and industrial use of minerals entered a new phase in Europe. The First World War exposed how vital minerals had become in national industrial policy. In Europe in the years leading to the War Holland gained in prominence. Now, the colonial geologist successfully infused his peripheral mineral obsessions with the Centralist desire. After retiring from his Indian services in 1909, Holland accepted in Manchester University the chair of geology. He came back to India in 1916 as the chairman of the Indian Industrial Commission. After the War was over he became a

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81 Holland, "Presidential Address", 1908, p. 16.
82 See MacLeod, op. cit., p. 360.
member of the Viceroy's Executive Council and a member for Commerce. 86

Soon he resigned due to differences with the Viceroy Lord Reading, and succeeded Sir Alfred Keogh as the Rector of the Imperial College of Science and Technology. His success as an educational administrator led to his appointment in 1929 as Principal and Vice Chancellor of Edinburgh University, in succession to Sir Alfred Ewing. He held the office for 15 years, retiring in 1944 at the age of 76 as Emeritus Principal and Vice-Chancellor of the University. 87

All these years Holland had held many other prestigious positions as President of British Association, Vice President of Royal Society etc.

This metropolitan man had begun his career in the periphery. His international discourse on minerals was rooted in India, in his reorganisation of the GSI and the redefining of geology. In spite of his international fame, he maintained his contacts with India and continued to take special interest in its mineral. He came to India thrice after resigning from the GSI. What is interesting is that in his journeys between the Centre and periphery his notion of science, and the application geological knowledge to practical purposes remained the same. For him geology in India had the same connotations as it had in Europe. He was not ready to play the limited role that had marked the careers of the early geologists of the GSI. It

86 “Holland”, p.235
87 Holland also held several held other important posts simultaneously. Between 1915-16 he was President of the Institution of Mining Engineers, London. Later, he was President of the Institution of Mining and Metallurgy, the Institution of Petroleum Technologists, and Chairman of the Royal Society of Arts, between 1925-27. Between 1927-30 Holland was Chairman of the Empire Congress of Mining and Metallurgical Institutions. In 1933-34 he was President of the Geological Society of London and in 1933-36 President of the Mineralogical Society. He also served the British Association as Sectional President in Geology in 1914 and in education in 1926, and was President of the Association at its meeting in South Africa in 1929. In addition he was the Vice-President of Royal Society in 1924-25. In 1944, after his long academic stint with Edinburgh University, Holland in 1944 reassumed his interest in the administration of learned and technical societies. He rejoined the Council of the Institution of Mining and Metallurgy as a Past-President, and became Foreign Secretary to both the Geological and Mineralogical Societies. He subsequently was the President of the International Geological Congress in 1945. Holland was also showered with international recognition. He had already been knighted in 1908. He was an Honorary D. Sc of Calcutta, Melbourne and Johannesburg and a L.L.D. of Manchester, Glasgow, Edinburgh, Aberdeen, St. And: w's and Queens Universities. He was a Bigsby Medallist of the Geological Society of London (1913), an Albert Medallist (1939) of the Royal society of Arts, a Major in the British territorial force from 1910-1919 and Deputy Lieutenant of the County of Edinburgh from 1931, Ibid, pp.235-6
is in this refusal of Holland, that the second contradiction between colonialism and universality becomes apparent.

Holland’s first point of dissent from the Centralist ideas was in his search for peripheral autonomy for scientific research during his early days in the GSI. The second was in his linking of geology and industry in the colonial world.

His search for peripheral autonomy can be seen in his active leadership in the Board of Scientific Advice against the dominance of the Royal Society of London. The Royal Society in this period (1880-1920) played an increasingly expanding political role and assumed special responsibilities for “foreign affairs” in science, in its work for Colonial Office and the Board of Trade. The result was the formation of an Indian Advisory Committee (IAC) in 1889 on scientific research in India. Simultaneously, in India, Curzon formed the Board of Scientific Advice (BSA) to supervise scientific research in India and advice the Indian government and also report to the IAC. From the very first year, (1903) Holland, the newly crowned Director of the GSI attended its meetings. Originally, the BSA was subordinate to the IAC but soon found the IAC “patronising”. This resulted in a revolt by the BSA and by Holland against the IAC. As Roy MacLeod put it, this conflict demonstrated the differences between the “assumption of ‘colonial science’ administered from London, and the ‘independent’ scientific objectives of men working in the field”.

The conflict also reflected Holland’s attempt to develop practical geology for industrial development in India and the IAC’s disapproval, as the society was more keen on completing the geological mapping of India.

In Holland we see a peripheral scientist who refused to accept terms and conditions of the periphery. He was keen to exploit the full possibilities that science offered in a colonial ‘under developed’ country. For him, the logical extension of the discourse on minerals was a discourse on industry. If geology had to associate itself

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88 MacLeod, op. cit.,
89 Ibid., p. 359.
90 Ibid., p. 383. See MacLeod, for a detailed version of the conflict.
with mineral and mining industry in India, it had to deal with industrialisation. Holland, argued that the association of geologists with the men from industry was a ‘natural’ one and that the interest of “science and industry are bound together”. 92 Similarly, he felt that the development of minerals had to be balanced by initiatives given to industry. Otherwise, in a country like India with few industries, the optimum development of its mineral wealth would be meaningless.

**Holland and Indian Industries**

European initiative in Indian industrialisation had a long if chequered history. The earliest efforts were probably of a little known private engineer William Jones (not Sir William) who migrated to India in 1800 establishing a big industrial complex near Calcutta. He was instrumental in the employment of steam power for the supply water to Calcutta and in the Srirampur Paper Mills. Artisans of Howrah, the industrial twin city of Calcutta, trained by Jones’, endearingly addressed him *Guru*, meaning teacher in Bengali 93

It was during the viceroyalty of Curzon that this spirit got an impetus. A prominent figure during Holland’s time, was Alfred Chatterton, who joined the Madras Education Service as Professor at the College of Engineering. In 1906 Chatterton was made head of the department of industries. He tried to improve traditional technologies like the handloom to increase production. He also attempted to develop the Chrome tanning of leather without machines and to set up an aluminium vessel factory at Madras. Other Europeans also had various ideas. 94

What is interesting about Chatterton’s industrialism is his dilemma regarding its scope and nature in India. To begin with, India posed “a great problem to the civilised world”. 95 It had abundant cheap labour, while the industrial mechanical culture of the West was seeking to replace man by machine. Thus the western model of industrialisation was not applicable to India. Also, Chatterton found in India

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92 See p.96, above.
95 Alfred Chatterton, *Agricultural and Industrial Problems in India* G.A. Natesan and Co.
conditions and attitudes opposed to large-scale industrialism.

It (India) has not yet accepted the factory system nor will it do so willingly, the undivided family has to be reckoned with and the extreme sub-divisions of property renders productive efforts on a large-scale difficult. Comfort rather than luxury, a moderate rather than a vast fortune-these are ideals of enlightened Indian.96

This comforted his Morrisian heart and increased his urge to preserve this situations, "... there is no reason why it should not strive to move forward to a goal more in harmony with its own tradition than is that presented by western civilisation".97 Having rejected the western model, India provided to Chatterton the scope for a unique 'experiment' of industrialisation without mechanisation,

...It is possible that we might now with advantage turn to our attention to developing the functions of the man rather than the power of the machine, to evolving a system the object of which should be to employ human labour to the greatest extent possible and in the way most advantageous to the individual.98

Unlike Chatterton, industrialisation never posed structural problems to Holland. Holland's engagement with industry was a logical extension of his involvement with geology and minerals. To that extent the western model, which it had exemplified, was perfectly acceptable to him.

A major theme pursued in arguments on minerals in the GSI was the need for India to industrialise and not to let her valuable mineral wealth to be exported. In the very first Quinquennial Report, he noted the difficulty to profitably procure India's copper-sulphate reserves. In western countries, he observed, with modern metallurgical and chemical industries, the by-products of copper-sulphate were now an indispensable item of profit. It was impossible to procure copper-sulphate in India because of the lack of allied industries and it had, thus, to be imported. The solution

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96 Ibid., p.22.
97 Ibid., p.23.
98 Ibid.
was to complete the ‘economic cycle’ and develop chemical and metallurgical industries in India. Elsewhere, he criticised GSI’s earlier focus on coal and stressed the need to develop other minerals, particularly manganese.

His discourse on minerals ran parallel to his discourse on industries. Thus minerals like iron and manganese needed for industrialisation, were, “far more important to a civilised community than gold and precious stones”. In 1905 he noted with enthusiasm that the increasing surveys of minerals over the last two years, were preparing the base for all-round industrial development in the country.

...The recent discoveries of aluminium ores and the demonstration of the existence of iron-ores in quality and richness sufficient to counter balance the heavy assembly costs of other raw materials required to manufacture iron and steel, will create the condition necessary for the utilisation of our enormous supply of coal and for the development of bye-products which will insure the gradual increase in the production of these materials of which India is at present dependent on foreign countries.

Holland was also taking interest in other industries, dependent on geological knowledge including building materials, like stone, concrete and cement, which he maintained formed, “the best guides to the industrial development of the country”. For him, the lack of such material and the subsequent dependence on imports was surprising in India, which, “owes its reputation for architectural monuments, as much to the fact that it possesses an unlimited supply of ornamental building stone as to the genius of the people...”

But in his ideas, minerals remained the core of a country’s strength and in this regard crucial was the iron and steel industry. Holland’s advocacy of and interest in the Indian iron and steel industry has to be studied in the backdrop of the

98 Ibid., pp.22-23.
100 Holland, “Presidential address”, 1908, p. 22.
102 Ibid.
commercial and industrial policies of the colonial state before the First World War. Then the dominant policy pursued by the Government of India was one of free trade, which was not only in the interests of Lancashire but the imperial system. It helped to send a large portion of Indian exports to countries outside the Empire like America and Germany with which UK normally had a large deficit. This free trade meant little support for Indian industries and not much government investment in it. The few steps that the state took such as the creation of the Department of Commerce and Industries in 1905 almost by the Madras government to manufacture aluminium or the setting up of cottonseed-oil mills at Kanpur few and were always short of funds. On the whole there was no systematic policy of helping new industries by active financial assistance or guarantee of the market.

However, the case of the iron and steel industries was different. The last decades of the nineteenth century marked the end of the British hegemony of steel in world markets. Britain was losing out to Germany and Belgium and was not able to restructure its domestic steel industries. The situation worsened after when by 1899, when Belgium became a serious competitor superseding British steel exports to India. This, together with the growing need for steel in Indian railways and other constructions made the Government of India seriously consider developing the iron and steel industry, without sacrificing free trade, in 1900. But the lack of interest exhibited by among European capitalists cleared the rise of the path for Tata Iron and Steel Company (TISCO), which came up in 1907.

Holland’s arguments in favour of iron and steel industries were concurrent to these developments. In a note to Curzon in 1905, while advocating the cause of TISCO, he pointed and that half of the private imports into India of steel came from Germany and Belgium, warning that unless similar industries were developed in India, it would soon become a large market for German steel.

However, Holland’s project went beyond the British national and imperial

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105 Ibid., pp. 50-53
106 Bahl, *op. cit.*
interest. For Holland, the question of mineral development and the subsequent industrialisation of India remained the central questions. In example in the same note to Curzon he mentioned that while imports of British iron and steel into India formed an unimportant fraction of the total production of England, yet, there were “iron makers I know at home who would willingly see the industry strangled in India for the sake of the small fraction of their total profits”.

It was in this light that his criticism of the export of manganese, a crucial raw material in the steel industry, might be viewed. In the first Quinquennial Review, he observed with regret that Indian manganese resources were exported to the three great steel producing countries of England, United States of America and Germany. He commented that the only way the trend could be curtailed was by developing a “flourishing steel manufacturing industry” in the country, which would also ensure the economic development of even lower grade manganese.

For him, the weakest feature of the colonial Indian mineral industry was the export of raw material, a policy whose elimination was necessary, “as early as possible”. Indian foreign trade had been,

for the most part a simple exchange of those materials produced easily and cheaply under the condition of rapid reproduction in a tropical country climate, for the manufactured and artificial products of more highly developed countries in Europe and America. It is essentially a primitive form of trade, practically a barter, between two countries utterly unlike in their natural condition and products.

He pointed out that there was no efforts were made to stop this by developing modern mineral industries in India, which in England already “forms the nucleus of a great web of trades”. Stressing the case of manganese, he showed now the pattern of trade hurting Indian’s interests.

108 *Ibid*.
111 Quoted in P.K. Ghosh, “Contribution of the Institute to the Mineral Industry of India”.
We are sending out manganese-ore at the rate of half-a-million tons a year... and are thus not only depriving the country of one of the natural products necessary for steel-making, but are receiving in return only fraction of its market value. The simple export of a raw product that cannot be reproduced, and yet is essential to the industrial development of the country, is not a form of trade that can be regarded with unalloyed satisfaction: We are paying dividends out of capital...\textsuperscript{112}

In this passage the early forms of Holland’s discourses on the questions of mineral wealth and national security may already be gleaned. His arguments on India in the early years were the basis of his subsequent thesis.

Yet, Holland’s early experiences in India were not exactly similar to that in Europe. His discourse on minerals had to encounter very different realities here. One basic difference was the contemporary industrial conditions. In India mineral-industrialism appeared a rather distant preoccupation. To resolve that, he took resort to the Indian past in search of an earlier industrial era. Holland saw in India’s present industrial conditions a great decline from the past when India was noted for her mineral industrial products. With a touch of regret he compared the past with the present.

There was a time when India occupied a prominent place in the metallurgical world, when smelters of iron and steel and artistic workers in copper and brass in the country. Today the manufacture of iron by the primitive lohar is restricted to areas far removed from the railways which distribute the imported article; no lead-mining now exists in the country; copper and brass-wares are made entirely from imported materials, and every attempt to work the known copper-deposits has come to grief.\textsuperscript{113}

By this comparison of the past and the present Holland internalised his industrialism within India. If she was advanced in industries at one stage, she could aspire to become so once again. But for this modern industrialisation, Holland

\textsuperscript{112} Holland, “Presidential Address”, 1908, p. 51.
\textsuperscript{113} \textit{Ibid.}, pp. 23-24.
stressed. India must depend on modern science following the European and American example. Holland asserted that science was the only hope for India in ‘modern’ times for science to him was universal.

The fact that applied science in Europe has enabled the chemist and the metallurgist to beat the Indian producers...does not necessarily show that the special products of the tropics are doomed to give way to the artificial substances of Europe. The science that has overcome the disadvantages of climate in Europe is free to the world, and can be utilised also to turn our natural advantages to account in India. (Emphasis mine).

In his attempt to locate industries within India Holland became an early advocate of the developmental discourse in India. His enthusiasm around discipline erased the boundaries between Centre and periphery. Thus Holland could stress that coal consuming minerals such as iron, manganese were in more need of support in India rather than coal itself, thereby sidelining a mineral, which, to Deepak Kumar, was the ‘crux’ of imperial geological interest.

In 1908, Holland noted with enthusiasm that in the last two years there were a rise in internal demand for copper and aluminium. Consequently, the question of developing industries on such minerals was more likely, “than it has been during the past thirty years in which our most serious failures have occurred”. Here it would be relevant to remember that this was the time that Holland was involved in his conflict with the IAC.

However, the GSI in spite of the reforms brought about by Holland, remained too general an institute, with too many responsibilities throughout the subcontinent to effectively investigate purposes of mining and mineral industries. As the Director of the GSI, he felt the absence of a society devoted entirely to the technical sciences, where the findings of a geologist could be freely discussed for a

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114 Ibid., p. 50.
115 Kumar, “Science Resources and the Raj”, p. 70.
comprehensive knowledge of the deposits, the best methods of their utilisation as well as of the mineral industry. An earlier attempt to start a Mining Institute had already proved abortive.\textsuperscript{117} The need felt to make a fresh start led Holland into another organisational initiative when he founded the Mining and Geological Institute of India (MGII) in 1906 along with W.H. Pickering the Chief Inspector of Mines.

The MGII and Industrialism; Organisational Reforms II

The idea of bringing together geologists and mining engineers so that they would have the power and influence to set up high professional standards through a democratic professional institute originated in Pickering's mind.\textsuperscript{118} He felt that though the work of geologists were published by the GSI, the 'bye-products' of geological investigation were never are recovered and brought to the light of the day. What was published in the official publications were not subject to free discussion and criticism or appreciation by men in the mineral industry for a proper appraisal of the facts. Often, men in the mining profession were not aware of how kindred problems were being dealt with in mines next door, or were unduly secretive of their experiences, which, he felt, was fatal for technical advancement.\textsuperscript{119}

In Pickering's ideas Holland saw the fulfilment of his own views that men of science should mix more freely with those from practical fields. He saw in the MGII an ideal platform for stressing the links between minerals and industrialisation. Thus was formed the institute with the support of geologists, mining engineers and metallurgists and marked the beginning of the professional relationship between geologists and mining engineers in colonial India.\textsuperscript{120}

\textsuperscript{116} Holland "Address", 1908, p. 25.
\textsuperscript{117} P.K. Ghosh, \textit{op. cit.}, p. 50.
\textsuperscript{119} \textit{Ibid}, p. 24.
\textsuperscript{120} Logan Hovis and Jeremy Mouat show how the period between 1880 to 1930, with the increasingly technical and specialised nature of mining and mining organisation, led to the growing status of the profession of mining engineers in European and American mines. See their, "Miners, Engineers, and the Transformation of Work in the Western Mining Industry, 1880-1930", \textit{Technology and Culture}, July 1996, Vol. 37, No. 3, pp. 429-456; Holland's emphasis on the need of geologists to collaborate with engineers and his personal partnership with Pickering was an outcome of changes taking place in the mining world.
According its Memorandum the thrust of the institute was threefold; to advance and protect the interests of mineral, metal and associated industries, to promote and disseminate mining, geological, metallurgical research in India for the development of mineral industries in India, to encourage, assist and extend knowledge and information on mining, geology, metallurgy to different sections of society connected with these industries through lectures, discussions, correspondence, building of libraries, publishing periodicals and journals.\textsuperscript{121}

So on the one hand mining and mining engineering were made an integral part of mineral research and the mineral industry along with geology. On the other, a specialised and technical institute was formed which sought to promote the cause of Indian mineral and mining industries and to initiate a new scientific technological discourse in the country.

The MGII became Holland’s platform from which he launched his agenda of industrial research, utilitarian science and industrial development. His two Presidential Addresses are clear examples of the same. To that extent the institute was a pioneer in its field in India, The parallels with the Asiatic Society were in its being a voluntary, non-profit, non-governmental organisation, attempting in developing and disseminating a new discourse on science through publications, lectures and seminars. Needless to add, however, their orientations towards science and knowledge were radically different.

In his Presidential Address of the inaugural year, Holland stated that he expected from the institute the, "...study of all branches of mining methods and mineral occurrences in India, with a view to disseminating the information for facilitating the economic development of the mineral industries of the country."\textsuperscript{122} Such technical institutes, he pointed out, had already become very successful in America in helping the mining industry because of which, “there is no industry in

\textsuperscript{121} P. K. Ghosh, \textit{op. cit.}, p. 51.  
\textsuperscript{122} Holland, “Presidential Address”, 1907, p. 30.
America which shows better average financial results than mining”.  

Holland also put forward his agenda for technical education and vocational training among the British officials in India. Technical education was needed, he argued, so that a class of technically efficient assistants would be available to provide the backbone of industry. He also advocated the representation of industries in councils of education so that a more practical interest could be created in industry. This, he argued, was the responsibility of the Geological Survey, by spreading ideas of practical geology and to produce cadres. Drawing from his teaching experience of the Presidency College, he criticised government policies for neglecting technical education. He pointed out that the GSI’s,

“...second rule provides for the dissemination as well as the accumulation of the data which are necessary for developing our mineral industries, and I take it that the absence of a class of technically efficient assistants, due parts to in-efficient educational methods, is at present our chief handicap.”

For him the purpose of education was not to create technical manpower through university courses but also to teach science to the wider public. Only then, he believed, could science and industry prosper in India.

In his farewell speech to the MGII before leaving for Manchester in 1909, Holland warned his colleagues against the “dangerous simplicity of our mineral industries in this country, and their consequent condition of unstable equilibrium”. He predicted that the mineral question in India would soon acquire larger proportions. A rising population, dependent on western technology and material condition would consume more mineral products. What was necessary was to

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123 Quoted in P. K. Ghosh, op. cit., p.51.
124 B. R. Tomlinson, “Searching for a ‘Suitable Boy’ Technical Education in Colonial India; 1880-1920”, read at the conference on Colonialism, Education and Nationalism in India, “March 19-20, 1996, Educational Records Research Unit, School of Social Sciences Jawaharlal Nehru University, New Delhi
126 Ibid., p. 21.
127 Ibid,
128 Ibid., p. 19.
oppose government export policy when necessary and initiate mining and utilisation of such products on a large scale.\textsuperscript{130} He ended by saying, "...when therefore, this question of economy becomes acute, as it will do in the next generation, remember that this Institute was founded to fore stall government interference, and to make restrictive measures unnecessary. I wish the Institute, the industry, and everyone of you success."\textsuperscript{131}

Holland left India in 1909 but came back again in 1916 as the Chairman of the Indian Industrial Commission (IIC) by which time the imperial perspective towards Indian industries had somewhat changed. World War I had revealed to the colonial state the dependence of the country on external sources for many commodities. The railway system was dislocated as a result of shortage of materials, supplies of drugs and dyes which also become scarce. Consequently, the government realised the need to set up manufacturing sectors within the country. Another strong pressure was Indian nationalist opinion on Indian industrialisation.

The great majority of politically conscious Indians approved state intervention to encourage industrialisation. There was a proliferation of formal economic associations, local chambers of commerce, trade associations and groups of industrialists in two the industrial centres of Bombay and Calcutta. An important national level co-ordination body was the Annual Industrial Conferences, first organised in 1905 and held simultaneously with the meeting of the Indian National Congress. This gave a new dimension to Indian politics hitherto unconnected with industrial issues. The Swadeshi movement also demonstrated how the industrial question could mobilise mass support. The IIC, was a culmination of this growing pressure on the government to own up to the responsibility of industrialising India.\textsuperscript{132}

The Government of India, therefore resolved to examine the question of a new industrial policy and a dispatch to the Secretary of State in 1915, suggested that after the war, India must become a manufacturing nation. Consequently, the IIC was

\textsuperscript{130} Ibid.
\textsuperscript{131} Ibid., p. 85.
established in 1916.\footnote{Viswanathan, \textit{Organizing for Science} : The Making of An Industrial Laboratory, OUP, Delhi, 1985, p. 41.}

Thus Holland came back to India, this time more as an administrator than a scientist. By this time, he also had more agency and scope to pursue what he had attempted a decade ago. Holland now focused on a general industrialisation in India unlike the earlier period, when he was only involved with mineral industry. He also had government sanction for his pursuits, this time. What had helped Holland to get this responsibility was the changing image of the geologists in the War. As Roy MacLeod has shown, the war led to the emergence of geologists as “scientific-statesman”. The First World War, in essence a struggle for topographic position, pushed geologists to the “front”.\footnote{MacLeod, "‘Kriegsgeologen’ and Practical Men” Military Geology and Modern Memory, 1914-18”, \textit{British Journal of History of Science}, Vol. 28, 1995, pp. 427-50.} To this was certainly added Holland’s earlier career, advocacy of Indian industrialisation and his subsequent prominence in Europe on questions of national security and minerals. Apart from Holland, the Commission comprised of Alfred Chatterton, F.H. Stewart, Madan Mohan Malaviya, Dorabji Tata, C.F. Low and Fujulbhoy Currimbhoy Ebrahim. Its report (ICR) was submitted in 1918.

Although never implemented, the (ICR) remains a very important document on the question of Indian industrialisation for many reasons. As Shiv Viswanathan had shown, it combined the ‘coloniser and the colonised’ to discuss India’s future industrialisation.\footnote{Viswanathan, \textit{op. cit.}, p. 46. See particularly the pages 39 to 96 of this book for a fuller} Moreover, Malaviya’s note of dissent gives us an important glimpse of the ‘Swadeshi’ angle to the whole issue, which for reasons stated earlier, I would take up in the following chapters. For the moment I will discuss how the (ICR) reflected Holland’s earlier views, although it would be wrong to see it as his sole handiwork.

The main weakness of scientific research in the country, according to the report, was its organisation. Apart from inadequate co-ordination between pure and applied research, there was no uniformity in the functions, powers and terms of service of the various surveys. The latter were pre-occupied with producing maps
and catalogues and charts with very little notion of the proper application of their data.\textsuperscript{136}

The Commission saw that the scattered and uncoordinated work by various surveys resulted in duplication and were a waste of money. Holland found scientists in India largely isolated each working in their own laboratories. Chemists were scattered in various surveys like the GSI and the Forest Research Institute, doing work that overlapped and producing reports that never reached the public. As he noted, "each little chemist in his province is independent, the amount of work he does is left to his own conscience".\textsuperscript{137}

The Commission observed that this lack of industrial perspective and of a sense of responsibility in scientific research was because scientists still continued research on the patterns set by the Asiatic Society.\textsuperscript{138} Holland observed, "to tackle the problem of developing India in competitions with the rest of the world, we have to move forward on a totally different scale" to "go beyond the present British system of every man going his own way".\textsuperscript{139} What the (ICR) recommended was the setting up of a centralised research organisation, which would provide specialisation, flexibility as well as co-ordination.\textsuperscript{140} It also proposed the establishment of an All India Chemical Service, under the Department of Industry, concerned with chemical research for industrial purposes. It was to be headed by a chemist who would advise the government on all chemical problems.\textsuperscript{141} It was on such organisation along with MGII that Holland placed his hopes of future industrial research in India.

Subsequent to the submission of the ICR, a conference for the consideration of the organisation of chemical research in India was organised in Lahore, in 1918.\textsuperscript{142} Holland acted as the President and in his address connected his international
discourses on war, science and industry to the question of industrial research of India. He showed that how during the First World War chemistry played a crucial role in international politics. His involvement with the question of war, national security, mineral development made him increasingly aware of the potentiality of chemistry in these fields. His industrialism had now taken a larger perspective. Holland was now going beyond his own discipline and the question of minerals to other sciences which had become crucial to contemporary industrialisation. Describing the existing status of chemical research under the colonial state as an "organised confusion" he showed how ineffective the system was,

... a single chemist to analyse the doubtful materials passed by the collector of the Custom, another to inspect our explosives, another to assist the Director of the Geological Survey, a tinctorial chemist to the Madras Government, and another lonely chemist in the Forest Research Institute of Dehra Dun. Each of these suffers from isolation, from a want of espirit de corps - from absence of prospects as each runs into his official coecum. According to Holland, there was a need for centralised laboratories in India for the chemical examination of its products, instead of sending them to England as was the practice. It was like referring "the investigation of an Indian village crime by report to the London police". He pointed out how the development of knowledge of chemistry in the West had led to the substitution of Indian agricultural products like indigo and sugarcane with artificial industrial ones, thereby ruining the export trade in these goods. The remedy was to develop India's own research and in turn produce its own substitutes for western products, which were being imported. Holland linked science to survival and national security, once again homogenising and universalising the patterns of 'development' throughout the world, "... science is not the monopoly of Europe, but we must do more than transplant the results, if it is to grow in India. We must undertake our own research work here".

143 Ibid. p. (3) 1.
144 Ibid. p. 2.
145 Ibid.
146 Ibid.
147 Ibid.

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Conference decided that a centralised chemical research institute should be formed, to advise the industry. Such advice should not be free of charge as was common with the GSI.¹⁴⁸

Holland came back to India for a third time in 1920. Meanwhile the Imperial Mineral Research Bureau was formed to keep in touch with the economic situation. It watched the fluctuations of production and consumption, exports and imports costs and prices throughout the world, to detect any threatening shortage or over production in any quarter of the Empire. Holland thereafter came to India to organise a Department of Industries to co-ordinate with the Bureau.¹⁴⁹

He influenced the Government of India in 1920, 1921 and 1922 to convene Industrial conferences to deliberate on how to give effect to the recommendations of the Industrial Commission and to promote co-operation between the provinces, and the Government of India on the industrial question.¹⁵⁰ In the 1920s in his keenness to promote Indian industries led Holland order the withdrawal of prosecution against a Bengali promoter who swindled the government over some war contracts. He was afraid that if the prosecution were successful, the vast industrial empire built by this man would collapse, constituting the retardation of the industrial growth in Bengal.¹⁵¹ In his last speech at MGII, Holland expressed his desire that both GSI and MGII should play an active role in organising the Department of Industries. It was at this time that he expressed a desire to see the School of Mines at Dhanbad to take shape, something which was in the pipeline for quite some time, “I shall be disappointed if I cannot before retiring from India for the third time, be present as the opening of the Dhanbad School of Mines.”¹⁵²

Holland along with others like Chatterton was one of the most brilliant and prolific promoters of the industrialisation of India in the crucial years between 1900 and 1925. Holland’s role is important because of his link to a science; geology. His discourse on industrialisation was also a discourse in science as it sought to shape the

¹⁴⁸ Ibid. p.10.
¹⁵⁰ Bagchi, op. cit., p. 57
¹⁵¹ This act attracted a lot of criticism from the European press and the Viceroy Reading, as Holland was seen to tolerate Indian corruption. Dewey, op. cit., p.244.
attitude of geologists towards their subject. This is where we are getting our focus back on geology and discuss other geologists who explored similar possibilities. The next section would focus on this.

Industrialisation without Holland

Minerals and industrialisation had become a crucial theme in the geologists' perception of their science in the years leading to and following the First World War. To them it had become the symbol of the industrial civilisation. Simpson, a President of MGII commented in his Presidential Address,

It has been entirely the use of minerals, beginning with stone implements, which has enabled man to raise himself from the savage state to his present high degree of civilisation, and there would seem to be no end to the further advances that we have yet seen or even dreamed of are in store for mankind.

The MGII attempted to co-ordinate between geology, mining, industry and government to initiate an industry-friendly, state-oriented, scientific and technical debate. Its publication, Transactions, bore an impress of Holland's spirit. The subjects dealt with were the chief industrial minerals and their mining and geological aspects, ore sampling, coal mining, mining technology, labour conditions, transport, screening of minerals and mining accidents. The housing of labour, sanitation of mines, explosives and fighting colliery fire were also focused upon. A combination of geology, mining and metallurgy was the subject area of the Institute. In 1909, W.A. Lee, the chairman of the Indian Mineralogical Association, remarked that the MGII was providing prominent leadership on questions relating to mineral industries through collective discussion, "... By leading us to inform ourselves and each other, it helps us towards a larger measure of efficiency and enables us better

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152 "Annual Dinner", Transaction, Vol. XV, 1920, p.44.
153 Holland's career as an industry friendly geologist is important in other ways as well. The links between geology and industry are yet to be analysed at greater details. Paul Lucier makes this point, in his "A Plea for Applied Geology", History of Science, vol. 37, part 3, no.117, pp.283-318. A more detailed study of Holland's life and work would be thus very important. The colonial backdrop would only make it more interesting.
and better to do our duty to ourselves, to the mineral industry for which we labour, and to the land we live in. "\(^{156}\)

Over the next few years, much attention was paid to the practical aspects of coal mining. With the deepening of mines, arose the questions of better ventilation\(^{157}\) and the health of the miners.\(^{158}\) Henry Hayden in his Presidential speech in 1916, pointed out the problem associated with the lack of technical and practical knowledge. He urged Indian geology graduates to take up apprenticeship in English mines and thus acquire practical experience from daily labour.\(^{159}\)

In the GSI, too, minerals had become a major concern. In the very first *Quinquennial Review*, submitted after Holland's departure, Hayden and Fermor carried further his mineral discourse. Comparing figures of the import of mineral products with indigenous production of the same, they argued that the domestic demand for mineral was higher than its current production: it was felt that there was a need to develop these minerals within the country for the domestic market rather than to export them. They also pointed out that India possessed the mineral resources requisite for the supply of this demand. The report argued that iron and steel production was one of the core sectors of industry. It studied the chequered career of this industry in India. It noted that TISCO in spite of its early difficulties was beginning to show promise after government help.\(^{160}\)

Therefore, even before the World War I, we see both GSI and MGII taking initiative in carrying on the mineral-industrial discourse of Holland, the colonial situation notwithstanding. The MGII took active steps to stop the wastage of coal to help the growth of the iron and steel industry. The Institute was concerned with the wastage of limited reserves of coking coal used in steam raising and other non-essential purposes. The burden of criticism fell on the railways, the largest single consumer, which had to choose between a certain amount of wastage of coal and the


scrapping of the old engines. Shunting engines, it was said, spent a large part of the time just standing in yards and sidings, "blowing off steam". Such protests, coupled with other contributory factors, gradually led to an appreciation of the gravity of the situation by the authorities.¹⁶¹

The Institute also urged in favour of the right kind of technical education for the advancement of mineral industry. Almost every Presidential Address discussed steps for the improvement of mining education, and the training of mine managers and subordinate employees. Three members of the Institute were appointed by the government to enquire into the methods of mining education in England with a view to introducing them in a form best suited to India. On the basis of their report, the Indian School of Mines and Applied Geology was founded in Dhanbad. ¹⁶²

After the First World War, the entire mineral discourse took sharper edge in India. In 1919, C.W. McCale in his Presidential Address to the MGII argued that although the War had inflicted untold misery upon the world, it had nevertheless left its "beneficial effect in the stimulus it has given to the industries of India".¹⁶³ He urged that this opportunity to realise Holland's goal should be utilised.

I sincerely hope that the encouragement which has been afforded to Indian industries by the War may not be allowed to slacken after peace is declared and the good work started by Sir Thomas Holland and his colleagues may bear permanent fruit by enabling India to utilise and manufacture herself the raw material which she produces in such profusion.¹⁶⁴

In the post-war period, with the shift in imperial industrial policy, the pro-industrial initiative was taken up with greater enthusiasm. In 1929, Simpson in his Presidential Address to the MGII called for the protection of Indian minerals from misuse and the export of metals, which could be developed within the country.¹⁶⁵ He raised a simple but pointed question, "... I think it right to mention what seems to me

¹⁶⁴ Ibid., p. 16.
a very important point, and that is the question as to how far it is for the benefit of
this country to import any given articles rather than to produce them for her herself,
or to export any given articles rather than to make use of them at home?"166 For
Simpson, the objective of mineral development and production in India were, "... the
ultimate good of this country, whether that can best be secured by home
consumption, or by export."167

The colonial geologists also took the cause of Indian industrialisation in this
period to England. Tipper of the GSI, analysed the situation in detail in a paper called
'Recent Mineral Developments in India', read before the Royal Society of Arts in
London, in February 1930.168 Edwin Pascoe, the Director of the GSI in a lecture on
the same issue given at the Imperial Institute London, in March 1931 questioned
various aspects of imperial policy responsible for the lack of industries in India,

...Why should it be necessary to import annually even the small quantity of
2,400 tons of lead in the form of manufactured articles? Why is the soft-
coke industry so insignificant?... Why is a valuable manure like salt-petre
exported to increase the tea crop of Ceylon or to amuse other nations with
fire-works? The glass industry is expanding, but India's daughters still
spend some 850,000 each year on imported glass bangles and beads
although there are adequate supplies of sand suitable for glass making in the
country, itself. How long will it be before India ceases to import steel
articles and begin to provide the world with some instead. How long will
it be before this industry absorbs more of Indian chromite, tungsten,
manganese and perhaps magnesites?169

At the same time, we find both the GSI and the MGII following with interest
the international discourse on war, mineral and national security in which Holland
played an important role between 1918 and 1936. In response, and as required by the
Congress of British Association for the statistics of British commonwealth mineral

166 Ibid.
167 Ibid., pp. 28-29.
168 N. P. Gandhi, 'Presidential address'; Geology Section Proceedings of Indian Science
Congress (Hereafter Proceedings), Vol. 20, 1933, P. 337.
169 Quoted in Gandhi, Ibid.
the GSI prepared the list of Indian minerals.170 The MGII, similarly, sent B. Storks-Field and G. V. Hobson to Canada in 1927 to attend the Second Empire Mining and Metallurgical Congress, where Holland read a paper.171 In 1943, it submitted a “Review of the Mining Resources and Industries of India and their post-War Development”, to inform the Empire Council of India’s mineral situation.172

Thus the MGII and GSI’s engagement with the question of India’s industrialisation was marked by the dualism characterising Holland’s thoughts. On the one hand, they advocated industrialisation for India and on the other were their efforts to serve and protect the imperial interests. As I show later, this dualism was symptomatic to some of the inherent contradictions of their involvement with Indian industrialisation.

With the Second World War, the whole issue of mineral, industry and national security was taken up with urgency. The GSI focused on economic issues, particularly to the search for minerals required for war materials, and those minerals and ores not available from workable deposits in more accessible parts of India. It also opened a Utilisation Branch to help efficient marketing and the commercialisation of minerals during the War.173 All these steps were taken under the Director C. S. Fox, a follower of Holland’s ideas.

The Second World War gave a new perspective to geologists’ concerns with industrial development and national security in India. At this point India’s independence was also in sight. J. A. Dunn, in his “Suggestion for the Future Organisation of India’s Minerals Industry”, firmly established the cause for organising mining, marketing, industrial co-operation in minerals under the control of government.174 He argued that minerals industry should be developed by the state because of its non-profit motive and its ability to provide industrial security by controlling foreign trade, in which the GSI could play a more active role.175

173 Fox, “Annual Dinner”, p. 15.
175 Ibid.
With the War, the MGII also took part in the discussions on Indian industrialisation. In 1940 as the Department of Scientific and Industrial Research came into existence and deliberations on the formation of a chain of national laboratories were taking place. Members of this Institute participated in these events in their individual capacity or as its representatives.176

In 1944, R. A. McGregor gave his Presidential Address on "The place of the Technical Institutions in the Schemes for Post-War Development s of Indian Industry, with particular reference to Geology, Mining and Metallurgy". Arguing that technical institutes could act as representatives for scientific organisations, he proposed to the DSIR to recognise institutes like the MGII as its mouthpiece for the publication of research work and for maintaining close contacts with industry.177

In 1939, D. Farquhar in his Presidential Address had advocated the formation of an Industrial Research Board to look into the conservation and intelligent use of coal and thus prepare a situation to meet, "with the needs of the country both for the present and the future".178

The general enthusiasm for industry and minerals during and after Holland's time among geologists had given rise to attitudes strikingly different from that of days of Romanticism and Orientalism. This had also shaped the new attitudes through which science now sought to appreciate Indian nature.

**Industrialism and Indian Nature**

Michael Shortland has shown how the increasing mineralisation of geology in Europe cut off from the eighteenth century Romanticism with which it was associated in the earlier era.179 Mines and the miners symbolised political power, too grotesque and imposing for Romanticists to feel deeply about. The geology of the era of minerals was marked by a masculine attitude towards the Earth, as predatory, sexual combat.

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179 Michael Shortland, "Darkness Visible: Underground Culture in the Golden Age of Geology".
In colonial India this phenomenon took an interesting turn. The mineral and industrial discourse of India was centred around the assumption that India was an ‘underdeveloped’, part of the periphery, as the wealth of a country was determined by the extent of its minerals and industries. Subsequently the Orientalist passion and Romantic attitudes towards India’s natural world were challenged.

Geologists soon realised that India’s mineral wealth was not vast. Pearson, in the 1880s, had pointed out that the days of the romantic Orientalism were over and India did not seem as wealthy as it had appeared in Orientalist fantasies.

It was customary in former years to represent India by the figure of a pagoda tree under which one could recline and pick up wealth with no greater labour than shaking the golden fruit from the richly laden branches. Now-a-days some people think that either the figure has been misleading, or the tree has ceased to be fruitful, for the pagodas will no longer drop off with a gentle shaking, and even when one stands to and shakes vigorously they generally fall but in scanty numbers.\(^{180}\)

This realisation dulled the earlier scientific obsession with India. In 1910 W. A. Lee talked about India’s ‘poverty’:

We frequently hear it said that India is a poor country, in nothing is it more true than with reference to minerals. In comparison with its size India is in most respect a poor country and although its minerals, as yet largely untouched represent enormous wealth, when that wealth is considered as spread over a million square miles it seems somewhat thinned out.\(^{181}\)

England, with its superior mineral wealth and industry was now the real metropolis, the centre of abundance. He added that,

Considering that India is nine times as large as the United Kingdom, the minerals of India do not compare with the mineral wealth of the old country. There is more than twenty-times as much coal mined in Great

\(^{180}\) Pearson, op. cit, p.3.

\(^{181}\) Pearson, op. cit, p.3.

Britain as in India, and twenty five times as much of other minerals.\footnote{182}

Thus, India had become, "a goodly apple rotten at a very large core". As Adams put it in his Presidential address at MGII in 1912.

...nature had dealt unkindly with us (in India). Having laid down coal in Bengal in what can be called wonderful abundance, she has then proceeded to burn much of it and so render much of it useless for our requirements, and if it is true as is beginning to be borne in among many of us, that the great Jharia coal-field is a goodly apple rotten at a very large core, surely there is all the more reason for us to consider gravely our position.\footnote{183} (emphasis mine)

In the Quinquennial Review of 1919-1923, the contrast between the romantic perception of India's heritage and the harsh realities of present was expressed,

In ancient times people in India seem to have acquired a fame for metallurgical skill, and the reputation of the famous wootz steel, which was certainly made in India long before the Christian Era, has in all probability contributed to the general impression that the country is rich in iron-ore of a very high-class type... But most of these occurrences consist of quartz and iron-ore so intimately blended that only a highly siliceous ore of a low grade can be obtained without artificial concentration.\footnote{184}

Oriental nature was seen not just as a re-iteration of the 'richness' of the Orient. A major disjunction in perception had taken place. In such circumstances, the earlier urge to understand and know Indian nature was no longer a major pre-occupation. What was now needed was the "engineering" of that nature. In a way the task of intervention into Indian nature was now more direct. Terms like 'prospecting', 'operating', 'drilling', 'procuring' dominated scientific language. Viswanathan has shown how in Holland's writings the military metaphor was prominent as he said, "...the future of our (Indian) scientific men will have to be

\footnote{182} \textit{Ibid.}, p. 62.  
\footnote{183} \textit{Transaction}, \textit{Vol. VII}, 1914, p. 28.  

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regarded as part of a defence problem".\textsuperscript{185} Such thoughts co-existed with unmistakable traces of paternalism that marked the European involvement with industrial questions. People like Holland and Chatterton thought that it was their 'responsibility' to usher in Indian industrialisation. They never failed to point out the crucial role that Europeans had and would continue to play in this regard. That also explains why they took up this cause with such seriousness. Chatterton was sure that India would be unable to do without men such as him.

...a leaven of Englishmen will always be required to preserve the present high standard of service, and it is difficult to even imagine the time when the direction of affairs will pass out of our hands. Our numbers may decrease, but we shall have to give our best to India if we are to successfully continue the work that has been so well begun.\textsuperscript{186}

India was now placed, where it always belonged -- in the periphery. At a time-when science's romantic relationship with industrialisation had begun, India had truly become the white man's burden.

That, however, is not the entire story. In spite of industrialism, science's association with Romanticism was far from over. There were contending definitions of science and what constituted a scientific world-view. In some of the visions India still remained important. The next section briefly focuses on the scientific discourse that continued, in spite of industrialisation, to be obsessed with the beauty of India. This analysis will reveal the third point of contestation that was between industrialism and Romanticism.

\textbf{Beyond Industrialism}

There was certainly much more to geology than minerals and industry. In fact, the Industrial Commission found the scientific attitudes in the sub-continent far from suitable for industrial research. Hayden, the Director of the GSI at that point had said, "the primary object(of GSI) is the completion of the Geological map in

\textsuperscript{184} \textit{Records}, Vol. LVIII, 1925, p. 128.
\textsuperscript{185} Viswanathan, \textit{op. cit.}, p. 73.
\textsuperscript{186} Chatterton, \textit{op. cit.}, pp.339-340.
Annandale, the Director of the Zoological Survey of India was clearly averse to the ‘a priori’ emphasis on applied science and the bureaucratic hazards implicit in it. He thought that to deal immediately with practical issues was unwise while knowledge of Indian Zoology was still incomplete. The demands of the bureaucracy were certainly unwanted in science. Officials would expect ‘a fishery expert to be an expert fishmonger, as it would expect me, who has written a paper on reptiles to charm snakes’. 

Although sidelined by the force and unimpeachable logic of applied science, reverence for ‘pure’ science remained strong. Alfred Gibbs Bourne in his Presidential Address to the Indian Science Congress in 1917, remarked,

...it seems to me that a new danger of misconception in regard to science may loom in the near future, ...pure science may be almost submerged for a time by a wave of utilitarianism and it will require concerted and sustained effort to make people see things in their proper proportions.

The problems plaguing geology were the same both in India and outside. To stress the non-utilitarian aspects of geology, Prof. Parks, while addressing the geology section of the British Association for the Advancement of science selected, “Cultural Aspects of Geology” as his subject of address and said, “The science of geology is wide in scope and general in application; it deals with matter and life, with time and space it touches the philosophical and borders on the romantic; majesty and beauty are its essentials and imagination is necessary for its pursuit. The cultural value of such a science is not to be despised.”

Even Thomas Holland once commented on the lack of ‘vision’ and ‘aestheticism’ in utilitarian science. As he asserted, ‘Possibly, we now turn out better chemists, more specialised mathematicians and more efficient physicists than we did

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188 Ibid., p. 660.
190 W. A. Parks, “Cultural Aspects in Geology” (Presidential address), Report of the British Association for the Advancement of Science. 1925, (Hereafter Reports) pp. 55-74
in the old days but we imagine that we run the risk of producing less valuable citizens who are relatively happy only because they are blind to the beauties of the world around them.""191

If Holland, the high priest of applied geology thought in this manner, it shows that the days of Romanticism were not yet over. The discourse on science was, however, far more complex. The Second World War, by the importance it gave to "scientific" warfare had raised the sentiments towards pure, non-industrial science. So much so that ever the President of a utilitarian institute like MGII commented in 1946 that, "the most urgent need of the day is to oppose this philosophy (applied science) with all our might and at every point ... we must re-assert that the essence of science is that of knowledge and that the utility of science does not concern us primarily."192 The Second World War had contradictory results. On the one hand it hastened large-scale industrial research, on the part of institutions such as the CSIR in India and other countries, it roused deep feelings against industrial science on the other.

Regarding Indian geology, a brief perusal of the nature of the activities of the GSI in this period gives an idea of its varied field of interest, indicating that mineral research was just one of them. Its main areas of research, apart from economic geology included the Archoean Fundamental Complex, the Gondowana system of Continental deposits, the Deccan Trap, the Classification of the Tertiaries, the Tectonics of the Himalayas, the Indo-Gangetic Trough and Palaeontology.193

One of the major projects of the GSI was Dr. A. M. Heron's work in Rajputana from 1908 to the 1930s which clarified the problem of sedimentary Archoeans in the north -western sector of the peninsula.194

In the Central Provinces L.L. Fermor studied the Archoeans of Nagpur.

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191 Holland, (Presidential Address), Section L: Educational Science, Report BAAS, 1926, pp. 246-254.
193 D. N. Wadia, "Progress of Geology and Geography in India during the last twenty five years", in B. Prashad edited, The Progress of Science in India During the Past 25 years.
194 A. M. Heron, "Geology of Rajputana", Memoirs. Vol. XI.V.
Bhandare and Chhindwara districts for 20 years. Fermor’s actual project dealt with the correlation of the Archeans of different parts of India, using marbles as confirmatory evidence. John L. Grinlinton carried on Newbold’s studies on glaciation into the Lidar Valley to see how and when the Ice Age reached the area.

The most interesting work done in this period, however, was on the Gondowana system. It was in such studies that the Indian natural world remained central to scientific interest. In the first place, such research disagreed with the geological sub-divisions of Europe. Second, geologists from India, such as the Blanford brothers played an important role in challenging European theories regarding the early history of the planet. Third, the success of these geologists sustained a great sense of optimism and pride about Indian geology. In 1937, Holland in his Huxley Memorial Lecture delivered in London reminded the European geological community that it was Blanford “so long ago in 1879,” who had first pointed one the existence of an ancient Gondowa system, “well before Edward Suess gave the name Gondowana Land to the pre-tertiary Southern Continent. C. S. Fox writing in 1931 about Gondowana system stressed that such research in India had several consequences; it made the discovery of radio-activity a foregone conclusion, it removed all fear with regard to the end of the world by loss of internal heat and it revealed various new facts about structures of the earth and the beginnings of life on this planet. He added, “...Our studies of the Gondowana system and of related formation in India and other countries has thus a definite geological horizon of great value. In a sense, therefore, the dim and frozen continental region, ‘Gondowanaland’ was discovered by the Blanfords.”

The study and discovery of India’s natural world led scientists to a ‘lost

\[195\] Wadia, op. cit., p. 90.
\[196\] Fermor, “Correlation of the Ancient Schistose Formation of Peninsular India”, Memoirs, Vol. LXI.
\[198\] Cyril Fox showed how the Gondowanaland theory as developed by Indian geologists differed from prevalent theories on European sub-divisions. See Fox, “Coal in India- II The Gondowana System and Related Formation”, Memoirs, Vol. LVII, 1931.
\[199\] Ibid., pp. 14-17.
\[201\] Ibid., p. 17.
world' and it was this spirit of discovery that still fascinated geologists. For example, Guy E. Pilgrim's study on the Siwaliks opened new horizons on the question of the evolution of man. His discovery of the fossil "Sivapithecus Indians" a direct ancestor of man showed that homo sapiens were an early offshoot from gibbons.202

In L. L. Fermor's work the question of nation-hood was intrinsically linked to the geographical features of the region. For him India was an ideal nation because it was "one of the most natural geological and physical unit on the surface of the earth".203 Extending this geographical determinism he argued that man was ultimately the "helpless child of geology".204 In clear contrast to the contemporary emphasis on 'penetration' and 'exploitation' of nature by human, he considered that men should "... attempt to adjust national and international life to these factors so as to help the growth of national welfare and international peace, instead of as so often happens, pursuing, in indifference to these natural factors, courses of actions that tend to increase national and international in-equilibrium".205 Geologists thus still appreciated natural harmony and were ready to surrender to the 'designs' of nature.

Somewhere, Fermor's words connect with those of the geography teacher in Madras, James H. Cousins, who asserted that geography was a source of ordered knowledge and national consciousness.206 Cousins proved to be far more radical than Fermor in his anti-imperialism. Through his notion of neatly ordered geography Cousins criticised the Euro-centric treatment of colonial subjects, places and cultures. In many ways Cousins' work reflects, as Catherine Nash put it, a hybrid species with roots in the western assimilation of colonial cultures through Orientalism and exoticism as well as in genuine deference and respect.207

Colonial Indian geological discourse indeed had this hybrid character. Given

204 Ibid., p. 204.
205 Ibid., p. 205.
207 Ibid., p. 411.
the areas of unmapped ‘wilderness’ in India, European geology had still to ‘know’, ‘assimilate’ and ‘understand’ this nature. Indian geology thus combined elements of Orientalism, romanticism, industrialism and imperialism. Even in Holland’s works we find traces of such romantic imagination alongside his engagement with minerals. He attempted to stress the distinctness and uniqueness of Indian nature. He insisted on using separate Indian geological terminology. If Euro-centrism in scientific terminology was challenged, the alternative terminology that he suggested was even more interesting. He suggested the use of categories such as “Puranic”, “Dravidian” and “Aryan”. The Orientalist and scientific images of India’s past was linked. These terms became accepted standard terms in Indian geology. Here, Holland had followed an earlier tradition, that of early Orientalists such as William Jones who rejected Linnean categories for Indian flora in favour of traditional Sanskrit ones. Fermor took this project even further. He suggested that these ‘Indian’ terms could be taken outside the geographical confines of India. At the Eleventh International Geological Congress at Stockholm in 1910 he suggested that the term Purana could be used for the upper divisions of American pre-Cambrian rocks as they were similar to Indian structures.

Often to these Europeans the very logic of industrialism seemed alien in their ‘Orientalised’ India, still associated closely to the ethics of a non-industrialised world. The small experience of a mining engineer, Col. Agabeg, in the Chotanagpur coalmines illustrates that. While talking of the low mineral output he said,

On arriving at the working face of the colliery one day I found one man asleep, one playing the flute while the other two were undercutting and loading respectively. On being asked why their output had fallen off, the man with the flute replied, “...when you go out for Shikar, do you always get game?... It is the same in coal cutting; the beastly coal will not always come down”, and commenced playing his flute again.

210 Quoted by P.K. Ghosh, op. cit., p.58
The man "with the flute" was seen as the 'other' of industrialism whose logic of collecting resources were perceived to be of a different world.

A survey of the various papers of the Memoirs and Records of the GSI reveals that there was a continuity in the nature of its publications during and after Holland. More papers were being published on economic geology, but questions relating to mining and mineral development were yet to become significant areas of study in spite of Holland's interventions. As in the early period, location of minerals generally terminated its interest in the same. Moreover, with the formation of the MGII many of its mining concerns passed on to that body. The continued lack of involvement with mineral development and industrial needs, meant as Fox observed, that the GSI could never become an institute like the Bureau of Mines in the United State or Canada. 211 For Fox, the most significant model remained the geological department of the USSR, which in unique ways played an active role in industrialisation. 212 In USSR, geologists "had to prove their practical value in a thoroughly satisfactory way". 213 But, in India, the situation was different for "to many, including some geologists themselves the idea seems to be that their work is entirely a distant scientific business which may or may not be for practical value to the country that provides for them..." 214

The situation was such that as late as 1942, during World War II when the GSI was required to play a major role in mineral development, Fox found it largely incapable to do so. He found it difficult to explain to its staff that "the study of ancient animal remains or the radio-active property of the rocks or the optical behaviour of certain minerals is not the sole purpose of its (GSI) officers". 215

By expecting the GSI to play a role similar to that in USSR, Fox certainly missed the thrust of colonial needs. One reason why the GSI had not become more oriented towards industry was because the colonial government was never interested

214 Fox, "Annual address", p. 15.
in industrialisation. The greatest obstacle that Holland’s ambitious thoughts faced in India was the simple fallacy of industrialisation under colonialism. Even after the first World War, with the apparent shift in the industrial policy of the colonial state, industrialisation was marked by an acute lack of priority in the official mind. The fate of various Departments of Industries in many Indian provinces reflects this neglect. After the early 1920s, provincial governments did not set up any new industries. Financial aids, given to some large industries were not put to good use because the plants were poorly located and managed. The nature of industrialisation was at the best ‘stunted’. Large-scale production employing modern methods remained confined to consumer goods industries. The development of capital goods industries was extremely meagre and the share of modern industry in total national income was low. This was because as Basudev Chatterji has shown, India remained throughout the twenties and thirties crucial to the British Empire both politically and economically. India was still one of the largest markets for British merchandise. Traditional British industrial interests were powerful enough to insist on the pre-1914 nature of Indo-British commerce and still perceived India as supplier of raw material and a market for their goods.

In the light of such realities, discourses on minerals and industries by European scientists in India were poorly placed. Men such as Holland had created an illusory world, which had little to do with reality. These attitudes could be seen in Fox’s repeated comparison of India with USSR. It was because of this illusion that Holland for all his discussion on the need for the all-round industrialisation of India, never produced a critique of colonialism. His criticism of India’s foreign trade never questioned the imperial interests. Contradiction is most evident in the dual role Holland played as an advocate of Indian industries and a European statesman. His focus on national security and international mineral sanction never touched upon the need for political independence in the colonies. He never saw, while sympathising with the Indian cause, that his ideas if logically extended would ultimately need to tackle this question.

216 Bagchi, Private Investment, pp. 53-58
217 Ibid., p. 56.
218 Ibid., pp. 440-443.
219 Basudev Chatterji, Trade, Tariffs and Empire: Lancashire and British Policy in India, 1919.
Consequently, much of Holland’s efforts had little impact on government policies. Although highly respected, Holland would often be frustrated at the efforts of the colonial state. In 1909, when he resigned from GSI it was because of the colonial government’s rejection of his plans for the institute.²²⁰

Holland’s recommendations in the Industrial Commission were never implemented. Nor were the recommendations he made at other seminars.²²¹ Nasir Tyabji has rightly pointed out that although the government had instituted the Industrial Commission, and had paved the way for industries, “the government had not committed themselves to the financial implication of such measures”.²²²

With little demand from the industrial sector, the GSI never felt the urge to change its fundamental attitude. If its attention was divided over too wide a field, the lack of industrialisation also hampered the development of the MGII. The latter was guilty of narrowing its focus. In spite of the involvement of industrialists and geologists in its annual meetings, the day to day activities of the MGII were preoccupied with local coal mining problems. As a result it became an institute for mining engineers of local coal fields, while geologists were somewhat marginalised.²²³ This is what Holland pointed out when he visited the institute in 1920, and said, “I notice that you never ‘do Puja’... to the other constituent of your institute, namely, geological science”. He added, “As the combination of geological science with mining methods produces the mineral industries both constituents are recognised in proposing prosperity to the compound.”²²⁴ He also noted that the Institute ignored other minerals found outside Bengal and Bihar, which betrayed its original plans of helping the mineral industries of the entire subcontinent and bringing about wide scale industrialisation. The survey and development of minerals

²²⁰ "Holland", op. cit., p. 233.
²²¹ Bagchi, op. cit., p. 57.
²²³ From 1906-28, only five geologists held the office of President. The work of the geologists was dismissed as “mumbo-jumbo” and the geologist as a “snail hunting saxoflourist”, see “Annual Dinner”, Transactions, Vol. XXXIII, 1937, p. 55. On another occasion, Hayden, a geologist referred to the affairs of the MGII as “mineral totalitarianism”, See “Annual Dinner”, Transactions, Vol. 35, 1939, p. 47.
in different parts of the country, he felt, had unfortunately stopped.

Fennor too, a couple of years later pointed out that the Institute had overlooked the industrial and mineral development of the subcontinent and was only dealing with local coal-mining of the neighbouring region, whereas, "as originally founded (it) was intended to have a wide scope including the whole of Indian Empire in its vision". Clearly, both Holland and Fennor tended to see the problem of the industrialisation of India, not as a political or economic question but merely an 'organisational' one. The industrial, managerial ethics of the West had thus failed to grasp the realities of the colonies of the East.

The failure of these men to understand the ground realities reflects the weakness of the concept of industrialisation between 1900 and the 1920s. Curzon's notion of a 'new' state was an anomaly in the colonial situation. The state never took the initiative in industry as it had done for railways and irrigation. Financial and monetary policy were not subordinated to industrialisation. The dyarchic principles on which the Montague-Chelmsford reforms were based ended possibility of the co-ordination of policies between metropolis and the provinces. Additionally at that point the techniques employed by states to promote industrial development were crude and uncertain. India, therefore, with its complexity, diversity and size posed an impossible task in the colonial context.

The failures examined above reflect the difficult task that was undertaken in the period. Despite its dualism the links of this European industrialism with its Indian nationalist counterpart was unmistakable. MacLeod has indicated the institutional links between Holland's BSA and later day Department of Scientific-Industrial Research (DSIR) and the Council for Scientific and Industrial Research (CSIR). His plans to set up scientific research laboratories, anticipated the National

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227 MacLeod, "Scientific Advice", pp. 382-383.
Laboratories of the CSIR which were established after independence. In fact it is difficult to locate a binary oppositions between the nationalist and this European debates. As I show later, the nationalist discourse of modern industry drew upon ideas emanating from the Centre.