WESTERN SCIENCE AND MODERN INDIA: INSTITUTIONS, INDIVIDUALS AND DISCOURSES

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Introduction

This thesis is an attempt to understand the shared, conflict ridden history of western science and modern India. While western science played a crucial role in the constitution of the identity of 'modern India', it has been itself transmuted and redefined in the process. The area of this shared territory is thus vast. In temporal terms it spans a period of at least two hundred years, from the late 18th century to the present times. My thesis attempts to cover a major part of this period. Thematically, it involved issues like the discovery of Indian natural world by a new system of knowledge, origins of the Gondowanaland theory, introduction of the telegraph and railway systems, identification of science as the key factor in ushering a modern India, discoveries of Indian and alternative traditions of science as well as the declaration of the Indian Scientific Policy in 1958 as the mainstay of an independent India. Apart from these, there is the vast area where science had manifested itself in more diffused modes of political and social hegemony. This thesis does not attempt to address all these issues.

What I attempt here is closely related to my understanding of the problem of modern western science. Science has articulated itself in the modern world in primarily two diverse yet complementary modes. One was the growing hegemony of science in the popular imagination. The 19th and the 20th centuries were marked by an unprecedented popular consciousness about and participation in the discourse of science. Science as a result was analyzed, debated, re-analyzed in astoundingly diverse ways. It was through this larger debate that science redefined, reformulated and ultimately affirmed itself.

The other development was in the opposite direction. It was the increasing specialization and professionalisation of science in which its cognitive language and symbols were getting too refined and restricted for popular intervention. This process was aided by the relative insulation that science had achieved for itself from the larger social and cultural life by posing as a unique and supreme system of knowledge.

My work attempts at a rudimentary level, to initiate a dialogue between the two. In doing so it faces the danger of not belonging anywhere. Admittedly this is not a purely internalist critique of science where the focus is on its mode of cognition. Neither is it a study of the popular imagination on science. Instead, it attempts to locate the links of popular imagination of science with its cognitive content. In other words it tries to understand the simultaneous processes of popular legitimization and the elitist insulation of science. The simple question to ask is, how far was its cognitive content influenced or informed by its popular manifestation, as well as the larger social history within which it was ultimately located?

It is in such a quest that my 'individuals' become crucial. They were the ones who possessed the expert knowledge of science and practised the scientific method in their intellectual concern - the scientists. They had the unique location as social- beings interacting with the various social and cultural symbols on the one hand, on the other, they were also the select few endowed with the ability and the right to analyze science's cognitive areas in a modern world. An analysis of their careers and work would open up the areas of possible interaction between of the two worlds.

My focus on 'institutions' is not for an externalist social, organizational assessment of science. The institutions become important as representations of certain orientations, shifting concerns, changing times and social pressures. My thesis is thus a study of the interaction between these individuals, the science they practiced and the institutes they formed or belonged to.

Coming to the specific context of modern India, two phases in the history of science can be identified. The initial years leading to the second half of the 19th century was marked by a predominance of Europeans in the research and debate on science. The subsequent decades were marked by a greater and ultimately dominant presence of Indians. Although such a periodisation may often prove difficult in the face of clear instances of shared and parallel histories, the two phases were nevertheless marked by distinct orientations as well. In the European enterprise in India, science was marked by the zeal to know the natural world within the colony, identify and commercialize its resources for the colonial state and to usher in 'modernity'. For the Indians it amounted to the adoption, propagation, contestation and rejection of an alien system of knowledge as well as a search for an enlightened modern India. Yet, my project is to go beyond these distinctions. I wish to initiate a dialogue -- that between these two apparently distinct phases, for that seems to me a basic way to conceptualize science in modern India. What I attempt to show is not a deliberate, forced correspondence between the two, but the deeper and inarticulate areas of shared passions, visions and orientations. I emphasize the need to appreciate the shared terrain as well as the contrasts and contestations between the two.

I thus discuss men like Jones, Piddington, Tytler, Corbyn, Falconer, Holland, M.L. Sircar, P.C. Ray, J.C. Bose, M.N. Saha, P.N. Bose and their contributions and institutions and research organizations like the Asiatic Society, the Geological Survey of India, Mineralogical and Geological Institute of India, Indian Association for the Cultivation of Science, Bose Institute, Council for Scientific and Industrial Research - with which these men were involved. At the level of experience, my research on European scientists was quite distinct from that on the Indians. I had a feeling that I was 'discovering' these European men, most of whom have been long lost in the annals of Indian history. It was almost a romantic experience to unearth these men, their passions, their experiences in their practice of science in this country. The Indians I discuss here are of course, prominent individuals - even icons of modern India. Here my urge was to delineate the deeper implications, orientations and tensions of their work and their times.

The first two chapters discuss the nature of science as it was understood and practised in and around the Asiatic Society. The attempt is to understand how a metropolitan knowledge sought to articulate itself in a colonial world and the various tensions and contradictions such an enterprise faced. The third chapter focuses on the shift that took place in the culture and practice of science from the days of amateurish research under Asiatic Society to the more specialized searches of the G.S.I. It discusses the imperatives and expectations that such a shifts produced in the European engagement with science in this country.

The fourth chapter initiates the discussion on the emerging Indian participation in the debates and researches of science. It focuses on the Indian Association for the Cultivation of Science, which marked the first institutionalization of the nationalist Indian concern in science and its founder Dr. Mahendralal Sircar. Sircar's activities can be seen as setting the agenda for the future involvement with and 'cultivation' of western science by Indians. In the next two chapters I discuss how J.C. Bose and P.C. Ray sought to establish the Indian nationalist traditions in the researches of science. Their efforts were marked by two different yet complementary courses in that direction. The last chapter is a study of how the visions of a modern India were formulated in the writings of scientists. It analyses the various trajectories of this discourse and illustrates the growing social and political authority that these scientists increasingly acquired within the society.

PART I

EUROPEAN VISIONS

Introduction

The first two chapters will be a study of the discourse of science as it developed in and around the Asiatic Society in the late 18th and early 19th century India. The introduction of western science in India accompanied the assertion of British imperial dominance. The discussion of this origin has to consider not only the logic of imperial dominance in India but also the intellectual lineage of scientific thought in Europe.

The emergence of science since the Renaissance as a feature of European intellectual life was followed by two major periods of scientific changes. First, the intellectual revolution of the 17th century in which the cognitive basis of modern rational science was traditionally established; and second, the emergence of science as a professional activity in the early nineteenth century when the social structures which provided the basis for the integration of science into the fabric of social life were established.

By the late eighteenth century the scientific activity was acquiring a new cognitive and social status. The period 1780-1850 witnessed a major transformation in which the image of the `natural philosopher' as the investigator of nature was succeeded by the image of the `scientists', the professional investigator of technical problems. The professionalisation of science was reinforced by changes in the cognitive content of scientific knowledge, in which the secularisation of scientific thought was accompanied by the merging and consolidation of newly defined and specialised scientific disciplines. `Natural philosophy' and `Natural history' branched off to the disciplines of `Physics', `Chemistry', `Biology' and `geology', each with its distinct boundaries, subject, conceptual structure, technique of investigation and trained, specialised practitioners.[1] The specialisation of scientific activity was accompanied by

[1] For details see, Peter M. Heimann, "The scientific Revolution" in *The New Cambridge Modern History*, XIII, Companion volume, edited by Peter Burke, CUP, 1979.

increasing opportunities for the pursuit of a scientific career and the wider dissemination of scientific education in Europe. In the 18th century science had flourished in the universities initially as an appendage to medical education, and was firmly established at a few universities such as those of Edinburgh and Leiden, which had important medical facilities. The 19th century saw the further specialisation of courses in French, German and later at English universities, emerged science as a socially organised intellectual enterprise. A plethora of specialised societies devoted to geology; mineralogy, astronomy, zoology and engineering proliferated. The new professional self awareness led to the foundation of the British Association for the Advancement of Science in 1831, a body which sought to promote and patronize research by its meetings and research grants and setting the agenda of scientific research in Britain and in other distant parts of the earth. Others like the Royal Agricultural Society (1838), the Royal Botanic Society of London (1839), the Geological Society of London (1807) and the Zoological Society of London (1876) had also been founded.

The introduction of western science took place in India during this period of professionalisation and specialisation of the discipline in Europe. The thin and sporadic trickle of European medical men, naturalists, Jesuit missionaries and adventurers with different degree of scientific backgrounds and scientific knowledge, which had begun a century earlier had developed by the end of the 18th century into a steady and regular stream of scientists.

Much like Europe, scientific societies were founded in colonial India from the late eighteenth century onwards. The Asiatic Society of Bengal (1784) was the first to be established, closely followed by the Botanical Garden at Calcutta in 1787 in the pattern of the Kew Garden of London. Next came the Bombay Literary Society (1804) which later became the Bombay Branch of the Royal Asiatic Society. Several other clubs and societies were established in Calcutta, Madras and Bombay. The Madras Literary Society was founded in 1818. Several surveys, for instance, the Trigonometric Surveys, were organised by the late 18th century as well.

If Europe with its centres at London and Paris was the metropolis of the growing influence and knowledge of European Science, colonial India represented the periphery of such activities. What was the relationship between this metropolis and periphery in terms of scientific knowledge? George Basalla's three phase model referred to a 'spread' of western science from metropolis to the periphery.2 Roy MacLeod assigns more complexities to the relationship than the steady one-way flow of information which Basalla's model assumes.[3] He suggests that new information, drawn from the colonies can hold a vital, not subordinate position in metropolitan science.

One important element in this understanding of the metropolis-periphery relationship has to be in terms of the ways in which information and knowledge was collected in the periphery itself, which none of the above works seem to focus on. A study of the conditions and orientations of such research in the peripheries would not only help us to understand science in the colonies, but also enrich further our changing understanding of the construction of scientific knowledge as such.

One major development in the post war writing of the history of science has been the challenging of the 19th century assumptions of science as a continuous unfolding of objective thought. The writings of Kuhn, Feyerabend and Laudan have thoroughly established that scientific knowledge like all other forms of human endeavour is socially and culturally conditioned.[4] The strong elements of European culture in the constitution of scientific discourse, as identified by

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[2] George Basalla, "The spread of Western Science", *Science* 156, 1967, pp.612-613.

[3] Ray MacLeod, "On Visiting the 'Moving Metropolis': Reflection On the Architecture of Imperial Science", *Historical Records of Australian Science*, vol. 5, No.3.

[4] Kuhn, *The Structure of Scientific Revolution*, 2nd edition, University of Chicago Press, Chicago 1962 (1970); Paul Feyerabend, *Against Method: Outline of an Anarchist Theory of Knowledge*, Verso, London, 1975; Larry Laudan, *Progress and its Problems*, Routlege and Kegan Paul, 1977.

them, have robbed much of 19th century science's claim to universalism. In more recent times, Richard Rorty has stressed that science cannot be seen as an objective knowledge representing reality.[5] The Edinburgh School comprising of scholars such as David Bloor, Barry Barnes and Steven Shapin have seen science as an expression of social interests as social relationships often inform scientific pursuits.[6] While these arguments have been contested they have nevertheless provided fresh ways of looking at the question of the constitution of scientific knowledge and the formulation of new frameworks within which scientific knowledge can be located.

Derek Gregory and David Livingstone have argued that the visual representation of the world in the forms of maps can be a powerful and insidious way of conveying cultural prejudices.[7] Nicolas A Rupke in an interesting article has recently shown how the Continental drift theory incorporated the prejudices of `continentalism' i.e. the belief in the geographical superiority of one continent over another.[8]

Similarly in recent researches, the formation of scientific knowledge in the periphery has been seen to be an extremely complicated issue. Important researches have emerged to study this phenomenon with respect to England itself in relation to its provinces. Arnold Thackray's work on the Manchester Literary and Philosophical Society looks at the character of science in the province in an urban-local context.[9] He argues that the pursuit of science in the province can be seen as a means of the social legitimisation of marginalised men, as a mode of

[5] Richard Rorty, *Philosophy and the Mirror of Nature*, Oxford: Blackwell, 1990.
[6] David Bloor, *Knowledge and Social Imagery*, London, RKP, 1976; Barry Barnes, *Interests and the Grounds of Knowledge*, London, RKP 1977; Steven Shapin, *A Social History of Truth; Civility and Science in Seventeenth Century England*, University of Chicago Press, Chicago, London, 1994.
[7] Derek Gregory, *Geographical Imagination*, OUP, 1994; David N. Livingstone, "Lost in Space", *The Times Higher Education Supplement*, 11 March, 1994, p.15.
[8] Nicolas A. Rupke, "Eurocentric Ideology of Continental Drift", in *History of Science*, XXXIV, 1996.
[9] Arnold Thackray, "Nature Knowledge in a Cultural Context, The Manchester Model", *American Historical Review*, 79, 1974, p.675.

cultural self-expression and as an instrument patterning generational intellectual life. The 'progressivist rationalist' image of science served the need of this group to justify themselves in a changing society in which they were 'unwillingly cast in leading roles'. Ian Inkster, sharing Thackray's concerns, stressed the need to understand the motives and characteristics of social groups in their acquaintance with science.[10] He understands the dynamism, tension and ambitions of the provincial societies in terms of the local political structure, the contradictions with the local elite on the one hand and their relation and self-perception vis-a-vis the metropolitan societies on the others. Such dynamics also led to the growth of centres like that at Edinburgh as a 'provincial metropolis' which was essentially in competitive terms with the metropolitan societies. Such a complex grid of social and cultural factors has influenced my understanding of science in the colonies. My research would focus on the Asiatic Society and the individual scientists - to show how their work represented the articulation of larger social and institutional ambitions.

However, the marginality of scientific research in colonial India had one crucial component distinct from both Thackray's and Inkster's provinciality - its colonial reality in both its economic and cultural terms.

Science and imperialism, two of 19th century Europe's most thriving enterprises were linked at least to the extent that Europeans usually took their science along with them on their forays overseas. But was science always implicated directly in the imperialist project, as an active component in the panoply of economic imperialism? Contemporary historiography tends to suggest that western science in the colonies had only commercial implications. It demonstrates how the apparently scholarly researches on Indian topography,

[10] Ian Inkster, Jack Morell (Eds.) *Metropolis and Province Science and British Culture, 1780 - 1850*, Hutchinson, 1982, p.14.

geology, botany were guided singularly by commercial and administrative factors.[11]

Such an approach reduces scientific research to an extension of the state machinery and limits the scope of understanding the more complex issues. Moreover the individuals working in different parts of the country in such a scheme are reduced to mere puppets of that great project. It also leads to a pre-conception that a career made in the colonies was bound to be second rate in terms of scientific achievement, without any scope for creative research. One of my aims in this paper is to situate these men as important actors in the history of science in India and through them retrieve an important period of the Indian scientific experience. At the same time I would like to address the links between science and colonialism from a different angle, I would like to see what implication both the geographical and cultural location of India as a colony away from Europe had over the constitution and transformation of metropolitan scientific knowledge. I would like to explore the wider motives for pursuing science in the colonies as well as the myriad circumstances of its pursuits, and thereby make possible an evaluation of the determinants of the science produced. These would lead me to ask, for instance, what were the intellectual concerns with which scientific researches were carried out here? What were the experiences of a European discipline when applied to a land so far away from Europe? What were the experiences of these men who pioneered the process? What were their attitudes towards the `metropolis' - Europe and their more `privileged brethren' the ones working in Europe? What were their motivations for conducting such researches in India?

[11] The most prominent writer in this field is Deepak Kumar. See his *Science and the Raj, 1857-1905*, OUP, 1994;"The Evolution of Colonial Science in India: Natural History and the East India Company", in *Imperialism and the Natural World*, (Ed) John M.Mackenzie, Manchester University Press, Manchester and New York, 1990; "Patterns of Colonial Science" in *Indian Journal of History of Science*, 15,1, 1980; "Science, Resources, and the Raj: A Case Study of Geological Wastes in the Nineteenth Century India", *Indian Historical Review (IHR)*, vol.10, 1983-84. Also see Satpal Sangwan's, *Science, Technology and Colonization: An Indian Experience, 1757-1857*, Anamika Prakashan, Delhi 1991.

The colonial reality influences our understanding of Science in another way in the latter's role in the formation of 'colonial knowledge'. History writing on colonial India has never been the same ever since Edward Said's classic *Orientalism* was published.[12] The book not only questioned the various assumptions regarding politics and society of the `Orient' but had also opened up the scope for various fields of study in the east ranging from anthropology to literature.

Said argued that the knowledge about the Orient since the colonial period has been a systematic discourse by which Europe has been able to control and even reconstruct the `Orient' politically, sociologically, militarily, ideologically, scientifically and imaginatively. According to Said, European and American views of the Orient formed a condition in which the Orient was forced to live. In defining the Occident's distinction from the Orient, the European had actually legitimised the former's power over the latter. Although Said's work dealt primarily with West Asia, it has encouraged a number of researches on similar lines on South Asia particularly India.[13] However, there have been few attempts to link the cultural and social aspects of science with this question of Orientalist knowledge particularly in the late 18th and early 19th centuries.[14] Such an attempt is important because it was around the same period, under the same institution (Asiatic Society) and often by same individuals that researches on India's nature and culture were carried out. Moreover, both these forms of knowledge had strong implications for the exercise of imperial `power'.

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[12] Edward W.Said, *Orientalism*, Routlege and Keagan Paul, London and Henely, 1978.

[13] Javed Majeed, *Ungoverned Imaginings, James Mill's `The History of British India' and Orientalism,* Clarendon Press, Oxford, 1992; Raymond Schawb, *The Oriental Renaissance: Europe's rediscovery of India and the East, 1680-1880*, New York, 1984; Carol. A Brekenridge and Peter van der Veer (Eds), Orientalism *and the Postcolonial Predicament* Philadelphia, 1993; Gauri Viswanathan, *Masks of Conquest; Literary Study and British Rule in India*, Faber and Faber, London, 1989, 1990.

[14] David Ludden "Oriental Empiricism: transformation of Colonial Knowledge", in Breckenridge et.al. Edited, *op.cit.*, has talked about Rennell's Maps but not really approached the central question of science.

These chapters would thus discuss how the questions of metropolis-periphery, the colonial state and the Orientalist discourse influenced early scientific researches in colonial India. I argue that all these factors informed conduct of scientific researches in colonial India. There was an element of tragedy in the way the efforts of these scientists went unrewarded and unrecognized and that is probably why the later historians too have often forgotten to write about them. In my discussion the first part would discuss the `Quest' and the second would attempt to tell the story of the tragedy of such an endeavor. The approach here would be through the scientists primarily based on a close scrutiny of various research papers published by them in India in the various journals and other books.

CHAPTER - 1

The Asiatic Society: Its Vision of Science

By the 18th Century Science hàd dramatically changed European philosophy, culture and society. The obsession with the positivist pursuit of knowledge, the will to know about the world, to venture into untrodden territories and to find order and laws in the apparent chaos of nature, informed European rationalist epistemology. Science was integral to that agenda. The Royal Society came to epitomise that search, the endeavour for truth, in the 19th century. In 1820, Sir Humphrey Davy, on taking the chair at the ordinary meeting of the Royal society, lectured on 'Present State of Royal Society and the Progress and Prospect of Science'. He concluded with such assertions,

> Gentlemen, to conclude, I trust in all our researches are shall be awakened by our great masters, Bacon and Newton. I trust that those amongst us who are so fortunate as to kindle the light of new discoveries, will use them, not for the purpose of dazzling the organs of intellectual vision, but rather to enlighten us, by showing objects in their true forms and colours; that our philosophers will look, where it be possible, to practical application in science, not, however forgetting the dignity of their pursuits, the noblest end of which is, to exalt the powers of the human mind and to increase the sphere of intellectual enjoyment, by enlarging our views of nature.[1]

This positivist notion of science shaped the scientific researches of the Asiatic Society, which was organised on the model of the Royal society. The colonial research was fuelled by this same culture where science was perceived as an enquiry leading eventually, to enlightenment. While writing a paper for the Asiatic Society William Jones expressed these concerns for 'truth' and 'Vision'.

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[1] Charles Richard Weld, *A History of the Royal Society, with Memoirs of the Presidents Compiled from Authentic Documents*, Vol.II, London, John. W. Parker, 1848, pp.354-55.

> It is painful to meet perpetually with words that convey no distinct ideas, and a natural drive of avoiding that pain excites us often that (sic) to make inquiries, the result of which can have no other use than to give us clear conception. Ignorance is to the mind what extreme darkness is to the nerves; both cause an uneasy sensation, and naturally we love knowledge as we love light, even when we have no design of applying either to a purpose essentially useful.[2]

That enlightening knowledge was positivist science. Jones and his colleagues in 19th century India were practitioners of that faith. But what made the project more challenging, the 'darkness' more engulfing was the geographical and cultural location of India so far away from Europe. It posed new challenges to the scientific theories originating from the metropolis. Baconian science here had to conquer nature in a strange and remote land. Thus the spirit of exploration was central to these scientific pursuits in the colonies. Jones, while inaugurating the Asiatic Society, noted that there was so much to be explored and improved and the task was almost daunting;

> I could not help remarking, how important and extensive a field was yet unexplored, and how many solid advantages unimproved, and when I considered with pain that, in the fluctuating imperfect and limited conditions of life, such inquiries and improvements, could only be made by the united efforts of many.[3]

Jones' instructions to his colleagues thus were very clear, "...you will investigate whatever is rare in the stupendous fabric of nature, will correct the geography of 'Asia' by the new observation and discoveries..."[4] McClleland, a botanist, argued for the need to study the natural history of India even more directly. He believed that such researches faced with the unfamiliarity of India had much more to do here than in Europe. The task was to restore those 'new'

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[2] *A.R.*, vol. II, 1790, p.315.

[3] *Asiatic Researches, Comprising History and Antiquities, The Arts, Sciences and Literatures of Asia*, (Henceforth *A.R.*), vol. I, 1788, "A Discourse on the Institution of a Society. For Inquiring into the History, Civil and Natural and Antiquities Arts, Sciences and Literatures of Asia", pp.xii-xiii.

[4] *Ibid.*, p. xiii.

species, within the European knowledge, which were otherwise 'lost to the mankind',

> ... if Natural history has so much to recommend it in Europe, how much greater are the attractions it holds out to those who are destined to spend the best parts of their lives in India, where almost every step introduces us to objects, regarding which, the scientific world have little or no information, and where thousands of species of animals, plants, and minerals, are as lost to mankind from our ignorance of their nature and properties, as if they have never been created...[5]

It was in this intention of discovering a lost world that the project had its European rationalist, enlightened orientation. It was the celebration of the Western man and his urge to explore the unknown that placed him ahead of the natives of other worlds. Jones had articulated very clearly the 'Europeanness' of this enterprise,

> ... there is an active spirit in European minds which no climate or situation can wholly repress, which justifies the ancient notion that, "a change of toil is a species of rose" and which seems to consider nothing is done or learned, while anything remained unperformed or unknown.[6]

This marked the confirmation of the 'power' of this Western knowledge. Hugh Falconer's geological researches were an exercise of that 'power' of reason to 'order' nature, "The Almighty has given us reason, and left us, by the adequate exercise of that power, to investigate the laws and order of the creator."[7]

It is here that colonial scientists, faced with this task of encoding Oriental nature, found inspiration from the great prophet of their knowledge, Bacon. His emphasis on experiments, observations, human intervention in understanding nature, his philosophy of vigorous conquest of nature through reason by man and deducing order from chaos, stimulated their activities. Particularly in the

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[5] *India Review and Journal of Foreign Science and Arts*, (Henceforth *I.R.*), Vol. II, No.15, pp. 561-62.
[6] *A.R.*, "The Introduction', vol. I, 1788, p.1.
[7] Charles Murchison ed., *Paleontological Memoirs and Notes of the late Hugh Falconer*, London, Robert Hardwicke, 1868, vol.1, p. Lii.

unknown colonial world it acquired a new meaning and significance. Science for these men became a story of conquering the nature of this land, unfolding its enigmas and putting into order its disorderliness. In a long review of Bacon's *Novum Organon Scientariam* in *India Review*, a colonial scientist saw in his methods of `observation and experiments and consciousness' to arrive at `established universals', the `true and legitimate method' of scientific enquiry.[8] *Asiatic Researches* thus defined its scientific activities: (to) "acquire an accurate knowledge of facts to a synthetic explanation of particular phenomenon..."[9]

This obsession with synthesis and order was reflected in the various scientific surveys undertaken by the members of the society. This became a central logic for scientific surveys in colonial India.

The initiation of detailed topographical surveys based on a rigid framework, was undertaken around the closing years of the 18th century when the Great Trigonometrical Surveys were begun by William Lambton. Lambton wanted to ascertain the great geographical features of this country on correct mathematical principles: The maps of every district could then be combined into one general map.[10] The purely map-making work of the Survey of India, however, began at an earlier date-1767. By the 20th century it had surveyed and mapped 1,304, 453 sq. miles of India and Burma out of a total of 1,884,640 sq. miles.[11] Map making in the colonies had become and remained the primary of object of survey. So much so that Sir Sidney Burrand, Surveyor General of India, reviewing past work of the department, commented as late as 1905, "The primary

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[8] *I.R.*, Vol., VIII, No.8, August, 1843, pp. 486-501.

[9] *A.R.* Vol. XVIII. 1832, p.3.

[10] William Lambton, "An Account of a Method for extending a Geographical Survey across the Peninsula of India", *A.R.*, Vol. VII. 1808, p.312.

[11] D.N. Wadia. "Progress of Geology and Geography in India During the Past Twenty Five Years", in B. Prashad (ed.). *The Progress of Science in India during the Past Twenty Five Years*, Calcutta, 1938, p. 124.

object of a national survey is the making of Maps, and all operations are subordinated to that end...".[12]

The need and the process of arranging and institutionalizing the scattered materials of India were illustrated in the words of the geologist, Campbell;

> In collecting information on Indian geology, the greatest difficulty appears to be, that the number of people, who have time and opportunities of the pursuit, are very few; but if everyone who chooses to attend to the subject, would apply himself, to compile accurate description of the part of the country, adjacent to their station, one should soon have a valuable collection of the geology of isolated spots, which those who are employed by the government in those scientific pursuits could soon and easily connect together.[13]

In doing so a need was felt for further institutionalisation of societies particularly devoted to collecting and collating scientific information in a specific discipline. Campbell added,

> In the furtherance of this end, a geological society would be of the utmost advantage, - they would receive and assist in the discussions of such information, compare specimens, have chemical examinations made, and afford that information and direction to tyros which no printed work on the subject could give - and particularly any individual of the society who has had the advantage of studying the science practically in Europe, could then afford the most valuable information, in identifying minerals with those of Europe.[14]

Thus the rocks, the soil, the plants of the land had to be studied, understood, ordered and incorporated within the European metropolitan knowledge. An interesting methodology to understand such expansion of metropolitan knowledge through peripheral experience is provided by Martin Rudwick, through his concept of 'Liminal Experience'.[15] Rudwick takes up the

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[12] *Ibid.*, p. 125.
[13] Captain J. Campbell, "On the Advancement of Geological Science in India", *Madras Journal of Literature and Science*, vol. II, 1840, p.81.
[14] *Ibid.*
[15] Martin Rudwick, "Geological Travel and Theoretical Innovation: The Role of 'Liminal experience' ", *Social Studies of Science*, Vol.26, 1996, pp.143-159.

case of geology-a science where fieldwork is a central element. He shows that geological expedition in the past involved a double movement, from the familiar is the unfamiliar and back again. He compares the dynamics of this process with Van Gennep's classic concept of "Liminality' with Victor Turner's application of that concept to the processes of 'Pilgrimage'. The argument being that theoretical innovation in a field science such as geology may require, or at least be facilitated, by a pilgrimage-like process in which scientists are exposed to unfamiliar lands and surroundings. This leads to a growth of new insights which leads to the development of the hypothesis itself, the gradual transmutations which the original ideas undergo, as a result of the slow process of active cognitive construction in the scientists' minds.

This concept of liminality is particularly useful to understand scientific researches in colonial India, for its appreciation of the role of the individuals working in a distant land. The separation of the individual scientist from his 'home community' gives him the opportunity to develop and articulate new and distinctive insights without fear of being crushed at birth by the critical competitiveness of the 'common-sense' conformism of the group. Individual scientific researches hold a significant clue to understanding the researches in the colonies. Often scientific research was left to their own initiative and interest in the distant and remote parts of the country yet to be fully integrated in the British administrative system. For this reason it is important to identify these individuals and their interests to understand the directions their researches look.

The Individuals and their Researches

As in late 18th and early 19th century England only the medical colleges offered some semblance of a scientific education, most of these men had graduated in medicine and then joined the army in India as surgeons. But thereafter their lives followed very diverse patterns. Hugh Falconer, who was later internationally recognised for his paleontological discoveries was born in Forres (1808) north of Scotland. He proceeded to Edinburgh to study medicine and also followed up his interest in Natural history by studying botany and geology. After acquiring is M.D. he proceeded to London and studied Indian Herbarium under Dr. Nathaniel Wallich, a British Indian botanist. In the museum of the Geological Society of London he studied Indian fossils from the banks of the Irawaddi under Dr. Lansdale. In 1830 he proceeded to India as an Assistant Surgeon and in 1831 he was posted in Meerut where he worked with Dr. Royle at the Saharanpur Botanical Garden. Initially he was posted in the Shiwalik Hills and then in the higher Himalayas. It is here that Falconer collected for years fossils the study of which made significant contributions to geological science and were highly lauded in Europe. In 1837, he and Cautley were jointly awarded the prestigious Wollaston gold medal by the Geological Society of London. Falconer was one of the few colonial scientists who began and spent a large part of their scientific careers in a colony and gained high reputation in England. When he went back to England, he was a member of the Geological Society and read many papers on Glacial Erosion, the Himalayas and compared it to other mountain ranges. In fact he played a leading role in raising metropolitan geological attention towards the Himalayan mountain ranges.[16]

Frederick Corbyn, who was a unique organizer and editor, was one of the most important scientists in colonial India. He was born in Manchester in 1792 and passed his medical degree from London. In 1813 he was appointed to the medical service of the E.E.I. Company in their Bengal establishment. In 1814, he joined the troops assembled in the Tarain against the Nepalese under General Morley where in 1815 they suffered a great loss. In 1818, while serving the 25th Regiment, the troops suffered greatly from a disease known in India as the 'Tarai Fever'. In the same year Corbyn published a small tract describing the disease, its effects, and the manner in which he had counteracted these effects.

[16] Murchison, *op.cit.*, pp.xxiii - xxx.

From 1818 onwards Corbyn wrote continuously. In 1819, he gave a short treatise on Cholera, which was followed up in the next year by same additional observations on the some disease. His days in the Tarai regions enabled him to study its topography and he was supposed to be one of the first to discover the tea plant. In 1828, Dr. Corbyn wrote on the diseases of infants in India and in 1830 his larger work on Cholera was published. Four years later he became the editor of the *Indian Journal of Medical and Physical Science.* In 1836 he started a new periodical, *India Review and Journal of Foreign Science and Arts* which he continued to edit along with the other till 1842.[17]

Sir William Brook O'Shaughnessy, famous for his contribution to the Indian Telegraph system, also began his career as a surgeon. He was appointed as an assistant surgeon in Bengal in 1833. While in Bengal he wrote numerous articles on medicine, chemistry and other subjects but devoted his attention mostly to the electric telegraph. Anxious to introduce it in India, he published a pamphlet detailing the results of experiments conducted by him in 1839. He was subsequently appointed the director general of telegraphs in India, and was sent to England to collect men and materials. He returned to India and commenced work in 1853. The line between Calcutta and Agra was functional by March 1857. His efforts were recognised in England and he was knighted in 1856. Earlier, in 1843, he had been elected a Fellow of the Royal Society.[18]

Colonel Lambton was a pioneer in the field of topographical and trigonometrical surveys in India. He was appointed a barrack master in the province of New Brunswick in North America where he applied himself to the study of mathematics and topography. In 1799 he joined the 33rd Regiment at Calcutta and was a part of the army that seiged Tipu Sultan's capital.

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[17] *I.R.* vol.VIII, no.4, 1843, pp.201-10.

[18] Sir Leslie Stepher and Sir Sidney Lee (eds), *Dictionary of National Biography, From the Earliest Times to 1900*, OUP, 1917, vol.XIV, p.1204.

After the successful termination of the war with Tipu Sultan, Lambton put forward to the government, plans of a geographical survey of that part of peninsular India. This work subsequently became the nucleus of the great Trigonometrical Survey of India.[19]

These were men who to some extent received recognition and support for their work. Many others were not so privileged. T.D. Pearse, a pioneer in the field of Indian meteorology, conducted one of the first two meteorological observations in India between 1785 - 1788. He also took an interest in astronomy and wrote articles on astronomical observations between Calcutta and Madras.[20]

Francis Balfour made very important contributions on meteorology's connection with health. He probably received his M.D. from Edinburgh. He entered the English East India Company's service in Bengal as an assistant surgeon in July 1769 and was appointed a full surgeon on 1 August 1777. He retired from service on the 16th September 1807. Balfour not only interested himself in politics and medicine but devoted much time to Oriental studies.[21]

The two most interesting but forgotten characters are Dr. R. Tytler and Henry Piddington. Tytler was born at Brechin, Augurshire, Scotland. He commenced his medical career in H.M. service and was appointed in the Company's medical service at the Bengal establishment in 1807. He subsequently proceeded to Java and was appointed to the charge of 5th Volunteer battalion. During his stay, he made some valuable studies of the mythologies of that country. Dr. Tytler's attention was likewise attracted to the destructive and malignant character of the fever so prevalent in Batavia. Under the name of 'Benevolous', Dr. Tytler published in the *Java Gazette*, in 1815, some useful hints on the causes of the unhealthiness of Batavia. In March 1817, he was

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[19] *Gleanings in Science*, (Hence forth *Gleanings*), vol.2, no.15, March 1830, pp.73-82.
[20] *A.R.*, vol.I, 1788, pp.57-121.
[21] Stepher and Lee, *op.cit.*,, vol.I, p.970.

directed to take charge of the medical duties of Jeshore district in Bengal. While at this station he printed a concise narrative of facts connected with the Cholera which occurred in that district during the months of August and September (1817) and made some observations on its symptoms, causes and treatment. He was also well-grounded in anatomy, surgery and mathematics. But the field where he made significant discoveries was that of electro-galvanism, where he claimed to have made discoveries similar to those of Faraday and prior to him. He also studied the influence of magnetic geological geometry upon the science of geology. This versatile man died in Futehgarh, unknown and unsung.[22]

Henry Piddington, a meteorologist, was also the foreign secretary to the Agricultural Society of India, sub-secretary to the Asiatic Society, founder and curator of the Museum of Economic Geology, president of the Marine Court of Enquiry and Coroner of Calcutta. He was in the mercantile marine, apparently in the East India and China trade, and was for some time commander of a ship. In 1830, he retired from the sea, was engaged in the culture of coffee and indigo and the manufacture of sugar. During that period he contributed various notices on agricultural subjects to the *Transactions of the Agricultural and Horticultural Society*. The work for which he is best known is his series of twenty five Memoirs accompanied by charts on the Law of Storms in the Bay of Bengal. Between 1839 and 1851 he continued to give accounts of all the important cyclones that occurred in the East. In fact it was he who coined the term 'cyclone' for the peculiar swirling storms of this regions.[23]

Three points of note emerge from the above descriptions. First, that these men had an extremely diverse range of interests, from botany to electro-magnetism. Second, that these men were keen to explore whatever natural environment their job placed them in a foreign land. In fact it was often this geographical diversity of their locations that contributed to the enormous range of

[22] *I.R.*, vol.III, April 5, 1838, pp.40-46.
[23] Stepher & Lee, *op.cit.*, vol.XV, pp.1142-43.

their researches. These individuals had imbibed the scientific ethic of Europe a pursuit of knowledge, a search for truth. It due to this commitment that they took up these researches which were outside of the terrain of their official jobs. They conducted such studies on their own, mostly without the Company's instructions and often without its official recognition or sanction.

Their liminal experiences in conditions very different from Europe and also in the association with an institution like Asiatic Society often gave them a great degree of creative space. An interesting instance of such space away from the metropolis was in the works of Falconer and Cautley, in the study of the fossils of the Siwalik. Not having been versed in fossil oestology and stationed at the remote confines of the Siwaliks, they were away from any living authorities or books on comparative anatomy. Thus they devised their own methods. They established a Museum of Comparative Anatomy. In the surrounding hills, plains and jungles they slaughtered wild tigers, buffaloes, antelopes and other Indian quadrupeds, preserved their skeletons, obtained specimens of all reptiles which inhabited that region. They compared and discriminated between different recent and fossil bones, and reasoned according to the laws of comparative oestology and reached interesting formulations. It was on the basis of these findings that Falconer developed his theory of the geographical formation of India in which he described how the sub-continent, once an island, gradually was joined with the Asian mainland.[24]

Another area where this creative space was evident was in devising instruments. Lack of proper instruments and sparse supplies from England was always a problem. The scientists thus re-fashioned their own instruments.

For instance, there were certain interesting developments on the manufacture of the barometer, used to measure atmospheric pressure. In 1837 William Gilchrist, of the Madras medical establishment developed a self-

[24] Murchison, *Op.cit*, p.XXX.

registering barometer and a metallic tube barometer. The first one would, he claimed, record constantly and with scientific accuracy, the varying pressure of the atmosphere which so far was lacking in the study of meteorology. His instrument was constructed by suspending a barometer tube from one end of a balance, an apparatus being connected with the other end to record the oscillations occasioned by the varying weight of mercury in the tube or the varying . pressure of the atmosphere on the top of the tube.[25] A year later he claimed to have simplified the apparatus even further.[26]

The metallic tube barometer developed by Gilchrist was intended to remove a major complaint of meteorologists regarding the barometer. The common barometer was liable to be damaged as a result of the entry of the air, and there was a great danger of destroying the instrument in attempting to expel this by the only efficient mode: boiling the mercury in the tube. This problem was even more acute in India where once air had entered the tube the instrument became useless as only the maker of the instrument in England, could do something about it. Gilchrist thought it practicable to substitute iron for glass in that part of the barometer, which was necessary to expose to heat for expelling the air.[27]

Lieut. R.S. Shortrede also tried to remove certain shortcomings of the conventional barometer. He suggested a method to free the tube from atmospheric pressure, which would not involve boiling it. Dipping the tube into a base of mercury and thus using atmospheric pressure to remove the air in the tube, he believed, would serve the purpose.[28] He also suggested certain solutions to the problem of graduation in the thermometer.[29] Charles Hudson's

[25] William Gilchrist, Esq. "Description of a Plan for a self Registering Barometer and Construction of Metallic tube Barometer", *I.R,* Vol. II March 15, 1837, pp.16-19.
[26] *Ibid,* pp.17-18.
[27] *Ibid.*
[28] Leut. R.Shortrede, "On the Errors to which the Barometer is liable", *Gleanings*, Vol. III, 1831, no. 26, February, pp.51-54.
[29] Shortrede, "On the Errors of thermometer and on a correct method of graduation". *Gleanings,* Vol. III, 1831, pp.87-88.

developments on the water barometer were to ensure that would be of a more permanent use, removing the danger of accidents and disruptions. His method was to reverse the principle of the barometer, by replacing vacuum generally used in the tube by 'Plenum' or artificially condensed air. This had the same elasticity and expansibility and could correspond equally well with water, air or mercury. Above all the expense to construct it was also to be relatively minor. In fact, Hudson was hopeful of procuring a patent for it.[30]

James Princep was also involved in constructing various astronomical and meteorological instruments. In 1823, he constructed a pluviometer (to register the fall of rain) and an evaporameter (to read off the depth of evaporation) in Benaras. In the *Asiatic Researches*, he described his instruments with which he registered the rain-fall of and evaporation in Benaras.[31] In March 1833, he published the results of his experiments on the expansion of gold, silver and copper and two months later described a new barometer invented by him.[32]

These individuals and their researches were a part of the grand project of Asiatic Society to come to terms with the 'other' both geographically and culturally. Culturally, the object was to study the various aspects of Indian society tradition, law, religion that led to the formation of an Orientalist knowledge about India's past and present. Recent works on the nature and extent to which the link between Orientalist knowledge and power operated in colonial India have consistently ignored the various natural history researches like meteorology, botany, geology carried out under the same institution without providing a justification for such an omission.

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[30] Charles Hudson in a letter to the Editor *I.R.*, "The plenoerum on water Barometer", *I.R.*, July 1843, p.424-427.

[31] Princep, "Descriptions of a pluviometer and on Evaporation constructed at Benaras" *A.R.*, Vol. XV, 1825, p. XIII.

[32] "Determination of the constant of expansion of the standard 10 Iron Bar of the Great Trigonometrical Survey of India. Some approaches", *Journal of Asiatic Society of Bengal (Henceforth JASB)*, Vol. II, 1833, pp.130-43.

One fundamental link between the two forms of inquiry was that both were attempts by disciplines of European positivist epistemology like linguistics, grammar, anthropology, botany, and geology to come to terms with the 'other'. Both were western empiricist methods of manipulating, formulating and incorporating this alien land and society within the metropolitan discourse. Like the cultural project, the 'understanding' of Indian nature also buttressed 'control'. The scientific knowledge of Indian condition decisively provided the government in the years to come with the necessary premises to rule. At an indirect level, along with the Orientalist redefinition of the east and assertion of the cultural superiority of the west, western science became a dominant paradigm.

Critique of Euro-centric Knowledge

Another sphere where both the projects shared grounds was in their criticism of Euro-centrism. Although never consistent in his attitude, hostility towards Euro-centrism characterized much of Jones Orientalist works. In his critique of Voltaire's disapproval of Persian imagery, in his study of 'Mystical Poetry' of East we see in Jones elements of empathy towards the Orient. There was an attempt to have the intricacies of Eastern knowledge respected and accepted within western scholarship.[33] The scientific researches of colonial India were also an exercise to question the geographical Euro-centrism of western science, although its paradigms remained firmly within the contours of European epistemology. During the 19th century European science was influenced by the physiographical argument that north western Europe is located precisely in the longitudinal and latitudinal middle of world's continental mass. It gave rise to various Euro-glorifying maps that drew Europe at the centre of the global distribution of landmasses.[34] This had important implications for the idea of the cultural supremacy of Europe. The scientific works under the Asiatic society,

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[33] Rosane Rocher, "British Orientalism in the Eighteenth Century: The Dialectics of Knowledge and Government", in Breckenridge et. al. (eds) *Op.cit.*
[34] See Rupke, *op.cit.*, pp. 252-262.

although conforming to this cultural Euro-centrism, argued that the study of nature of Asia and could contribute crucially to Europe's understanding of the earth. To that extent the geographical centrality of Europe was being challenged.

This can be best illustrated in the science of meteorology. Meteorological researches in India tended to flourish not so much because of its commercial prospects for its scientific potentialities, in this tropical country. Due to its particular geographical location, a consensus had been reached among scientists working in India that India offered excellent facilities for meteorological studies. Although the basic objective of meteorological studies was to collect data from which to determine the climatic condition of this alien country, Indian environmental conditions proved to be favourable to the sudden of proliferation of such studies. As early as 1805, Francis Balfour wrote that the topical peculiarities, over the huge land scape of India particularly facilitated the advancement of this science,

> ... it is natural for those who are prosecuting (sic) discoveries in medicine and meteorology to look towards 'India' for some information respecting, the nature and peculiarities of the climate in which we live. Possessing as we do, the peculiarities of a tropical situation, with a more extensive field, and greater conveniences for making observation than any European nation, ever enjoyed before, its an expectation which they have reason to entertain, and which on that account, and many other consideration, are ought, if possible, to gratify...[35]

Balfour discussed in detail the particular advantages that India afforded for meteorological studies. With similar faith, further meteorological researches were carried out in India. Almost fifty years later Dr. G. Von Leibig, while discussing some meteorological observations, talked of the 'peculiar advantages' of this country: His report started this way -

> The following discussion of a few meteorological observations made on the Parisnath Hill in 1856, I started to submit to the society less because

[35] Francis F. Balfour, "Observation respecting the remarkable effect of Sol-Lunar influence in the fevers of India; with the scheme of an astronomical ephemeris for the purpose of medicine and meteorology", *A.R.*, Vol.II, 1809. pp. 6-12.

> they contain any new facts than with a view of drawing attention to the peculiar advantages afforded in India for the investigation of meteorological question by the great regularity of all atmospheric change.
>
> *A few days observation in this country will suffice to trace laws, the exhibitions of which would in Europe, require months and years of continued research...*[36] (emphasis mine)

Leibig's argument was that the shape of the barometric curves of one day in India was so regular that it was equivalent to the stabilization of a year's study in Europe. The questioning of Europe's geographical centrality had thus begun.

Henry Blanford who was the most significant meteorologist in colonial India, the geographical entirety/unity of the Indian subcontinent had more appeal than that of Europe. In the introduction to his brilliant work *Meteorology of India* (1877), he wrote about India as the 'epitome of atmospheric physics, because of its varied conditions, its seas, the high altitudes, the vertical sun, etc.:

> It is a safe prophecy that, given a few earnest and intelligent workers this country will one day play a part second to none in the advancement of national meteorology. As England is an epitome of stratigraphic geology, *so is India an epitome of atmospheric physics*, and, while it presents within itself, the most varied condition of form and surface, and together with the seas, the great primary contrast of continent and ocean, ranging through nearly 30 degrees of latitude, and during five months of the year is bathed in the intense radiation of a vertical sun, it is, so to repeat, a secluded and independent area. On the north, the Himalaya shuts in the lower half of the atmosphere and constitutes the natural limits of the monsoons, on the south an only less defined meteorological frontier excites in the zone of all but unvarying, barometric pressure of all equatorial belt.[37] (emphasis mine)

But such sentiments were not restricted to one particular science, which might have been enriched by particular conditions in India. Similar feelings were

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[36] Dr. G. Von Leibig, "Discussions of Some Meteorological Observation in the Parisnath Hills", *JASB*, Vol. XXVII, 1858, p.1.

[37] Henry F. Blanford, Meteorology of India: *Being the Second Part of the Indian Meteorologists' Vade Mecuem*: Office of Supt. of Government Printing, 1877, pp. 3-4.

reflected in colonial India with regard to geology, the major 19th century European scientific discipline. Campbell argued that the very important research of primary rocks has been neglected in Europe because the Isles of Great Britain provided few opportunities for the study of primary geology. Thus in the absence of sufficient data, no appropriate theory could be developed. India, to that extent, was a great advantage, against which Europe "sink into insignificance";[38]

> The Peninsula of India presents a vast field for the study in question, where the formation of enormous magnitude, extent sometimes for 50 miles, presenting to view the same kind of rock, until its peculiar nature and varieties can no longer be overlooked. *Compared with this vast field, the primary formation of Great Britain and even of Europe sink into insignificance, and we require but energy and application, to collect the necessary knowledge, and possibly to unravel the law by which the formation has been aggregated*[39] (emphasis mine)

The Archdeacon of Calcutta, J.H. Pratt on the Himalaya regarding the Geodetic problems, also reminds us of the famous researches. To him India with its diverse surface features - highest mountains, great plains followed by large ocean stretching to the South Pole provided the ideal facility for examining the differential action of gravitational forces on the surface of the earth,

> ...Hindostan affords a remarkable example of this as the most extensive and the highest mountain ground in the world lies to the north of that continent and an unbroken expanse of ocean stretches south down to the south pole. Both these causes by apposite effects make the plumb line hang somewhat northerly of the true vertical.[40]

Colonial scientists believed that. India had to lot to offer to paleontology especially with respect to the Siwalik fossils. Falconer was singularly responsible for drawing the attention of the European scientific community to the Himalayan ranges. The finest hour of this claim for India's superiority came when he, while

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[38] Campbell, *op.cit.*, pp. 78-79.
[39] *Ibid.*, p.79.
[40] Pratt, *Figure of the Earth*, Macmillan and Co., London, 1860, p.49.

addressing the Royal Asiatic Society of London in 1844, claimed that through the geological researchers in India,

> The human race has been traced further back into time in the past than in any other quarters of the globe; and the tendency of all enquiries has been to show that the civilization of *atleast a large section of mankind first dawned in the valley of Ganges*.[41] (Emphasis mine)

Claims of this nature were made at a time when the study of geology was undergoing acute Euro-centrism in Europe. There was a presumption in England that the history of the Earth had been a teleological process and that the British Isles were composed of a uniquely complete succession of rock formation, the ultimate purpose of which was to bring about the pre-eminence of its civilisation. Falconer's claims show that Europe no longer enjoyed the lone superiority in this teleology. Other parts of the world like India were proved to be unique, too. At one level this was an aspect of the Orientalist challenges to claims of European superiority. At another, this was an outcome of the experiences of the European scientists working away from the metropolis, of the challenge they and their science faced in remote areas. Repeatedly we find scientists who had worked on Indian stratiography and geodesy referring to the `completeness' of Indian geography, to the presence of *all* sorts of geographical features rendering a comprehensiveness to such researches.

In botany and entomology too, some scientists found a comprehensiveness in Indian nature. Thomas Thomson who studied Indian plants remarked,

> To the philosophical botanist who is desirous of investigating the laws by which the distribution of plants is regulated, no flora in the world is more interesting than that of India,...The interest of the Indian flora lies in the absence of new forms, in the identity of its plants with those of other countries, in the occurrence of European plants on our Western mountains, of Japanese plants in the Eastern Himalayas, of Chinese plants in our dense Eastern forests, of a purely Egyptian flora in Sindh,

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[41] Murchison, *op.cit.* vol.I, p.1.

> of a Polynesian flora in Malaya, and of numerous African types in the mountains of the Madras Peninsula...[42]

In Thomson's words we see India being imagined as a confluence of earth's natural history, similar to the 'amphitheater' of ideas of Jones. In scientific terms the implications were clear. Through the study of the natural world of India one could possibly grasp the natural life of the entire earth.

We have to remember here that the European scientists' journeys away from their local conditions have generally been enriching and crucial to their knowledge. Charles Darwin's long period in South America, Alexander Von Humboldt's and Ami Bonpland's studies also in South America, Leopold Von Buch's long travels in many parts of Europe that were still remote and Charles Lyell's long trip through remote areas of France and Italy provided important links in their thinking patterns. But what was unique in the Indian case was the presence of an institution like Asiatic Society, which helped to codify and articulate this critique of Euro-Centrism both in terms of its culture and geographical location. To that extent these studies were not just a product of the fascination for the alien, they became an attempt to institutionalise comprehensively the search for an alternative metropolis. I would discuss this in greater detail in the next chapter.

However, this dual critique of Europe conformed essentially to that Euro-Centric epistemology from which these researches drew their inspiration. It was part of the positivist quest for facts. The critique emerged from the realisation that Europe did not provide all the information required to collect the knowledge of the earth, its culture and nature. India to that extent provided the scope for a greater expansion of that knowledge. The episteme of western rational knowledge confirmed and reinforced itself due to its very ability to relocate itself continually.

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[42] *JASB*, vol.XV, Part I, 1856, p. 414.

In a fundamental way, the Indo-centrism of the textual studies and the natural science researches differed from each other. The Orientalist project idolized Indian culture. They had a fascination for the rich, ancient and classical tradition of India. They believed that contemporary India was steeped in medieval darkness and a renaissance was possible only from within the original culture, by a return to its pristine sources. There was an attempt to preserve that tradition from the onslaught of British administration and law, which were considered to be alien to Indian society. This is explicit, for instance, in Halhed's recommendation that Bengali be cleansed of foreign vocabulary Persian, Portuguese as well as English.[43]

The Indo-centrism of scientific researches was an attempt to geographically re-locate western science. The colonial scientists were not aficionados of Indian or European nature. Their true commitment was to their discipline. Their science was a rupture with tradition, the Baconian 'new' method distinct from other traditions of studying natural history both in Asia and Europe. In colonial India the project of science thus represented a conscious process of introducing an alien knowledge to the condition of India. The scientists were conscious of their 'new' knowledge. It was a quest to make a new and fundamental statement about the Orient's natural world. In the Orientalist project the celebration of the Western civilisation was indirect and subconscious. At a conscious level it sought to celebrate traditional systems of knowledge. The scientific sojourns were a conscious advocation, of Western rationality to discover the 'truth' of Indian nature, hitherto unknown and unexplained. The intervention was thus more deliberate and direct. At that level it shared the very aggressive rational logic of Benthamite positivism which Orientalism opposed. The paradox is that both the projects were undertaken under the same institution and often by the same individuals.

[43] Rocher, *op.cit.*, pp. 229-230.

For a New Science

One must seek an understanding of the different trajectories of the two kinds of studies at least partly in the nature of 19th century science itself. Science had by then clearly defined its cognitive identity as distinct from and superior to other 'non-sciences'. It had also more directly associated itself with absolutist power and the legitimacy of the same. One way in which it could achieve that power for itself was by delegitismising all other traditions of knowledge, attacking all forms of existing culturally distinct social norms, thereby violating local customs in the interests of rationality and 'progress'.

In colonial India, early scientific texts give ample evidences of this reverence for the 'new' science and disregard for tradition. There was an interesting letter in *India Review* where the writer expressed his disdain for older forms of science like Alchemy and Astrology. He was surprised that an experiment in alchemy had found a place in the pages of the famous *Mechanic's Magazine* of England. He also expressed his shock at the fact that two European merchants patronized an Indian alchemist in an attempt to produce gold from dew-drops. The author of the letter termed these activities irrational and nonscientific and wondered how such subjects still attracted attention despite "the advance to which learning has attained in the present..."[44]

Henry Piddington's booklet called *Conversation About Hurricanes* is a very significant attempt on similar lines.[45] It was written in the form of an imaginary conversation between a naval scientist, Mr. Helmsley and his nephew who were acquainted with the 'new' naval science and two old sailors who depended on their traditional knowledge. The book is an unfolding of a drama in which the non-believers are persuaded to see the advantages of the new science. Mr.Helmsley, whom we can identify with Piddington, argues to convince the two

[44] "Scientific Follies", *I.R.*, Vol. II, Part No. IV, April 1843, p.235.

[45] Henry Piddington, *Conversation About Hurricanes: For the use of Plain Sailors*, Smith Elden, London, 1852.

sailors who initially reject his knowledge of 'the new fangled science'. But gradually he goes on to demonstrate how only the new science has the 'right' to be accepted as the only form of knowledge. Helmsley concludes, "I must affirm that it is you (the sailors) who have no right to deny what is plainly grounded on pure, though very simple, mathematical demonstration".[46] In the end, the inevitable happens. The final triumph of modern science takes place over the traditional one. The two sailors, initially such strong critics of the new science, come to accept its wisdom. One of the sailors finally exclaimed that this new science had to be learnt:

> ...so that our knowledge then would all be fore knowledge, both as to what had happened and what in all probability was going to happen. Well! that is certainly different from the time when we could only say that we were going to have a gale, and guess that the wind would veer so and so, in which the oldest and the cleverest of us often mistaken; but I think now that with a good look out on signs of the weather one can scarcely be caught unprepared.[47]

So the scientists' role was also to intervene and to propagate a new knowledge to change the existing one and also to convert the non-believers. The text of the booklet begins with this quotation from Bacon, "...those whose conceits are beyond popular opinions have a double labour; the one to make themselves conceived and the other to prove and demonstrate."[48]

The Asiatic Society from the time of its conception had in fact perceived the two projects as discrete. Although never articulated clearly there was a consciousness that these had to be treated separately. William Jones in his inaugural speech had said, "...If now it be asked, what are the intended objects of our inquiries, within those spacious limits, we answer,

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[46] *Ibid.*, p.4.
[47] *Ibid.*, p.93.
[48] *Ibid.*, first page.

MAN and NATURE, whatever is performed by the one, or produced by the other..."[49]

The 'Man' represented the Oriental self - its culture; language, tradition and poetry. 'Nature' represented the geographical contours of Asia - its physical world, natural history. Both were the 'other' of Europe, in terms of their character, logic and aesthetics. But the two had to be perceived separately. Throughout the society's history this separation was maintained. Jones himself was involved in the study of Indian botany in accordance with the Linnuean model which were distinct from his Orientalist studies. These studies are often overlooked within Orientalist scholarship. By the early 19th century, it was felt that a special body specifically for scientific research was needed within the society. On 1808, 7 September it was resolved that:

> ... a committee should be formed to propose such plans, and carry on such correspondence as might seem but suited to promote the knowledge of Natural history, Philosophy, Medicine, Improvements of the Arts, and Sciences and whatever is comprehended in the general term physics.[50]

A committee was formed accordingly and meetings were held, but after sometime they were discontinued. Again towards the close of 1827, several members of the Asiatic Society felt that the ordinary meetings of the Society were held at intervals too remote and for purposes too miscellaneous to be conducive to promote scientific investigation. Thus on the 2nd January, 1828 it was resolved at a General Meeting that a physical committee should be formed. Resolutions were passed at the same time empowering the committee to elect its own officers, to frame its own rules and to publish its proceedings as a distinct part of the *Asiatic Researches*[51].This, along with the Calcutta Medical Physical Society (1823) played an important role in giving a specialized and professional shape to scientific researches in this country.

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[49] "A Discourse......", pp.xii-xiii.
[50] *A.R.*, Vol.xviii, 1832, pp.i-ii.
[51] *Ibid.*

The second fundamental difference was in their links with Europe. The pre-occupation of the Orientalist works with Indian culture meant that its links with Europe were indirect. The logic and fulfillment of such a project was in focussing solely on the Orient. The Orientalist texts appeared in Europe as advertisements of Oriental culture -the reference points thus remained the 'Orient'. Science on the other hand, was not restricted within this paradigm. In spite of its sentiments for Indian nature, its inspiration was essentially from the metropolis. The involvement with Indian nature was not out of disillusionment with the metropolis similar to the romanticizing of the Orient by the Indologists. India was a land away from that metropolis the study of which, they believed, could enrich the metropolis. The strong links with Europe had its own contradiction in a colonial situation from which these men suffered. This can be located at many levels.

The Metropolitan Link

Scientific researches in the colonies under the Asiatic society were an European project. The geographical Euro-Centrism might have been questioned in the process but the cognitive content of such researches were direct offshoots of European intellectual concerns informed by their own historical experiences. The Indological studies were linked to the intellectual concerns of Europe, but such studies originated from an obsession with the Other, from a search for an alternative in a sense, to modern European culture. To that extent it was possible to attain their intellectual fulfillment at the spatial cultural site of the 'Orient' itself. Scientific researches in the colonies were a part of the metropolitan project of codifying nature on a global scale. Their researches were premised on conditions of universality. The fascination with Indian nature was thus partly an out come of its limilanility and partly a product of its association with the Indological project. This strong metropolitan orientation explains why an institution like the Asiatic Society could be founded in the peripheries as early as

1784 (even before its metropolitan counterpart was born) while a purely scientific institution was yet to be found in the periphery.

The sudden rise of world-wide studies on earth science were a product of Europe's growing concerns with the shape and age of the earth and its expanding territorial possessions. The urge was to consider the earth and its place in the universe in a fully scientific manner. The age of maritime expansion had already raised the various problems of the motion, shape and gravity of the earth. By the 19th Century the new scientific tools, aided by the Industrial Revolution and by the expansion of imperialism had revolutionised concepts of exploration, transport and mapping.

The early French scientific expeditions to equatorial South America as well as to the Arctic Polar regions in 1735 were, for instance, the outcome of the European concern regarding the shape of the earth.[52] Since 1838, resolutions passed by the British Association for the Advancement of Science pressed the government many times to extend the ordinance survey maps at home and abroad and to keep mining records and surveys on file.[53]

I would take up the case of geology first to show how such researches in colonial India were products of European scientific concerns for a universalistic, world-view.

Geology, the scientific study of the earth, during the late 18th century and early 19th century opened up a vast and unfamiliar sphere for observation. The study of rocks and fossils showed that the history of the earth had not covered the same stretch of time as the history of mankind, but extended back immeasurably before the appearance of man. The significant conclusion that was reached was that pre-human earth history had not been a single period of continuity, but a

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[52] D.N. Hall, *History of the Earth Sciences during the Scientific and Industrial Revolution, with Special Emphasis on the Physical Geosciences*, Elsevier Scientific Publications, Amsterdam, 1976, pp.127-129.
[53] Hall, *Op.cit*, p.262.

concatenation of successive worlds, i.e., of periods of geological history characterized by a particular extinct flora and fauna. A great chain of history appeared to unroll from the new understandings of rocks and fossils, analogous and complimentary to natural history.[54]

The reconstruction of pre-human periods of earth history was based on two separate areas of study. The first was linked to chemistry and consisted of the mineralogical classification of rock formations. Abraham Gottlob Werner initiated the geographical periodization of rocks through their chemical analysis. The second area of study was linked to medicine. Through a study of comparative anatomy, extinct animals could be identified using fossil bones. Johann Friedrich Blumanbach, Professor of medicine at the University of Gottingon, initiated such studies. George Cuvier extended these studies greatly in the field of vertebrate paleontology.[55]

Such studies began in France and Germany but by the 1820s this scholarship had made great strides in England particularly under William Buckland. English scientists came to be the finest and most sensational contributors to it. The English school of geology under the leadership of men like Buckland, Conybeare and Sedgwick was characterised by its work on the geology of England and Wales. These scientists were committed to diluvialism and to the progressivist synthesis of earth history in the 1830s.[56] Geology as a science in England rapidly rose to high status. In a little more than two decades geology or earth history with the help of inductive philosophy had climbed to the very top of hierarchy of scholarship in science. Herschel wrote in 1830, "geology, in the

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[54] See Rupke, *The Great Chains of History: William Buckland and the English School of Geology (1814-1849*, Clarendon Press, Oxford, 1983: also see Charles Coulston Gillispie, *Genesis and Geology: A Study in the Relation of Scientific Thought. Natural Theology, and Social Opinion in Great Britain, 1790-1850*, Harper Torch Book, New York, 1959.
[55] Rupke, *The Great Chain..*, pp.3-4.
[56] *Ibid.*, pp.17-18.

magnitude and sublinking of the objects of which it treats, undoubtedly ranks in the scale of sciences, next to astronomy".[57]

Thus geology consolidated itself as a discipline in the period between the 1750s to the 1830s. In 1743 the first geological map and in 1747 the first geological journal were published . In the period from 1790 to 1815 William Smith for the first time surveyed rock units over much of England and used fossils for the first time in that process. Soon fossil guided stratiography shifted to France and was applied to mapping Tertiary formation by Georges Cuviar and A. Brongniart. The year 1830 was marked by Lyell's publication of *Principles of Geology* which in many ways first defined modern geology. It demarcated the limits of the subject. It clearly stated that the study of the geological situation of present times hold the key to the understanding of the vast changes which occurred in the past.[58]

In the same period there were important dimensions of change in the European scientists' understanding of themselves and their relation to the rest of the globe. It was marked by an orientation towards the intensive exploration and the construction of a global scale of meaning through the descriptive apparatus of natural history. A major part of colonial Indian geology could be seen in the context of this consciousness. Geological sciences were introduced in India around the same time that these above mentioned changes in the philosophy of natural science were taking place in Europe. From the 1820s numerous natural history surveys based on the above mentioned premises had begun in different parts of the country.

In the 1840s, Dr. J. Adam, who was then working on the rock formation of Bundelkhand, clarified what geology meant to him, "To trace the changes on the ever-varying surface of the globe, to compare the present with the past, and

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[57] *Ibid.* p.181.
[58] Hall, *Op.cit.*, pp.230-233.

thus to study the history of its inhabitants in their several epochs of existence, from the shrub and insect upto man, the proud lord of all,..."[59]

In 1836, a colonial scientist expressed his reverence for this newly emergent discipline, "It has been said that no man can be considered enlightened without knowing something of geology".[60]

In this atmosphere of an emerging consensus about the purpose of their surveys both in Europe and the distant colonies, the metropolis often tried to inform and instruct researches in the peripheral areas. In 1832 a short essay appeared in *JASB*, titled "Progress of European Science: Theoretical Geology".[61] This essay sought to elaborate to those in India the motives with which geology was pursued in Europe. After having described how scientists in Europe were trying to develop and test different theories of earth history through their surveys of rocks and fossils, it added-

> Thus geology has almost ceased to be the science of observation alone, as it was so long its boast to be called, and it now challenges a share in the physical speculation of the atmosphere, the dynamical calculation of the mechanical, and primeval chronology of the cosmologist and historian...[62]

With the introduction of this expanding vision of geology the article next put forward its main objective. That was to inspire those in India to 'initiate such studies'. The suggestion was that the global implication of such a science necessitated that it should be undertaken in India as well. The passage pointed out that M. Edie de Beaumont, by his own and others' recorded observations had proved that whole mountain chains have been elevated at one geological period and that great physical regions have partaken of the same movement at the same

[59] Dr. J. Adam, "Memoranda on the Geology of Bundelkhand and Jabalpur", *JASB.*, Vol.XI, 1842, p. 393.
[60] "Review". *I.R.*, vol.I, 1836, p.151.
[61] *JASB*, vol.I, 1832, p. 515.
[62] *Ibid.*, pp. 521-525.

time. The confirmation of this hypothesis depended on further researches on the same line elsewhere,

> We must still look for evidence where on the synchronism of the elevation of these mountain may rest to our Indian geologists, whose exertion will naturally be stimulated to attempt the solution of the problem. Russia has been before hand with us in exploring their newly acquired portion of Asia,...
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> ...It did not come within our purpose to particularise any practical geological researches, but we have digressed in this case, the ground trodden (by Russians) is closely connected with our own Asiatic fields, and it may act as a useful stimulus to point out what our neighbours are about. The court of Directors have appointed to Madras an eminent geologist of whose researches in Sicily, the president of the Geological Society speaks in high terms, to him we look with great expectations, and when he enters the vast field, hitherto but partially visited by Voysey and Dangerfield...[63]

More specific guidelines were published in Indian journals. In one issue of *Gleanings in Science*, there were detailed directions for over 30 pages of referring to the means of testing out different metropolitan theories on geology in the Indian landscape.[64] Its objective was to provide the colonial geologists with information on recent theories of earth history, and thus stimulate similar researches here.

> When we see that many of the links wanting in one country to the chains of geological evidence are to be sought for in another; We cannot deny but that the progress of geology would be considerably accelerated by general and simultaneous effort on the part of our countrymen scattered over the eastern world...[65]

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[63] *Ibid.*
[64] "Direction for the Guidance of those desirous of making geological and mineralogical Observations", *Gleanings*, Vol.II, 1830, February, No. 14, pp. 41-48, 358-363.
[65] *Ibid.*

A set of directions from the Geological Society of London published in 1833 drew attention towards paleontology and the significance for its studies in 'distant countries'. It said,

> The G.S. (Geological Society) begs to impress upon the minds of all collectors, that the chief object of their researches should be specimen of all these rocks, marks, or clays, which contain shells, plants, or any sort of petrifaction...
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> ...That it should be a general maxim with geological collection to direct their principal attention to the procuring of fossils, organic remains, both animal and vegetable. These are always of value when brought from distant countries, especially when their locations are closely marked...[66]

Many surveys were undertaken in colonial India on paleontology and its involvement with the question of emergence of life. It is not to suggest that geological researches in the colonies were a product of instructions from the metropolis. The emergence of geological researches in the colonies have also to be understood, as I have pointed out, in terms of the status of Asiatic Society and the liminal creative space available to the scientists in that institution. I mention these instructions here to illustrate that in spite of this distance between the metropolis and the periphery the orientation of the researches were compatible. The very fact that such metropolitan instructions were published in the journals of the Asiatic Society shows the space available to the metropolis to attempt to instruct, direct and channelise researches in the colonies.

It was a question often of shared passions and visions. The individual scientists working in the colonies, who learnt their science in the academia of Europe had imbibed values and sentiments similar to those of the metropolitan scientists. Hugh Falconer while working on the Siwalik fossils exclaimed, "What a glorious privilege it would be, could we live back, were it but for an instant into these ancient times when these extinct animals peopled the earth!"[67]

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[66] "Circular Instruction from the Geological Society for the Collection of Geological Specimen, with a plate", *JASB*, Vol.II, 1833, pp. 557-558.
[67] Murchison, *op.cit.*, p.Li.

In another brilliant essay he expressed his fascination for paleontology, reflecting the same visions and imaginations of a sub-terranian world that was storming contemporary European geology,

> We have only to light the torch of philosophy to seize the clue of induction, and like the prophet Ezekiel in the vision, to proceed into the valley of death, when the graves open before us and render forth their contents; the dry and fragmented bones sum together, each bone to his bone; the Sinews are laid over, the flesh is brought on, the skin covers all, and the past existence to the mind's eye starts again into being, decked out in all the lineaments of life...[68]

Both Falconer and Cautley carried out several surveys fired by this imagination. In 1830, they jointly wrote about a new fossil 'Ruminanta Genious', found in the Siwaliks which they considered a major finding as it filled the crucial gap between the Ruminanta and Pachydermenta in the sequence of animal species.[69] In 1840 Caultey discovered another fossil-'Camelidae' which proved, he argued, that the camel lived at the same time with Sivatherium, Anoplotherium-Simia, hippopotamus and rhinoceros. This too was a link between Pachydermenta and Ruminanta.[70] The fossil remains of the hippopotamus in the Siwalik hills helped to recognize the character which distinguished the Siwalik species not only from the existing ones in Africa, but also from those of Europe.[71] Falconer developed his theory of the geological formation of India based on these researches.[72] According to him the sub-continent of India at an early tertiary epoch, was a large island, situated in a bight formed by the Himalayas and the Hindu Kush ranges. Several upheavals took place in the course of which the

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[68] *Ibid.*

[69] Hugh Falconer and Capt. P.I. Cautley, "Sivatherium Gigantium. A New Found Ruminant Genus. From the Valley of the Markanda in the Shivalik Branch of Sub-Himalayan Mountains", *A.R.* Vol. XX, 1830, pp. 1-23.

[70] Cautley, "On the Fossil Remains of Camilidae of the Siwalikhs", *JASB*, Vol.IX, 1840, pp. 620-623.59. Cautley, "Note on the Fossil Hippopotamus of the Siwalikh hills", *A.R.*, Vol. XIX, 1836, p.39.

[71] Cautley, "Note on the Fossil Hippopotamus of the Siwalick hills", *A.R.*, Vol. XIX, 1836, p.39.

[72] Murchison, *op.cit*, Vol. I, p.29.

plains of India were connected with the ancient continent, the Siwaliks were formed and the elevation of the Himalayas increased by many thousand feet. This event and the climatic changes which it involved caused the extinction of the Tibetan and Siwalik faunas. Elsewhere in the Narmada valley in central India, other scientists identified several fossils.[73]

There were also examples where geological theories developed in European landscapes were directly applied to Indian conditions. Captain Newbold attempted to apply the Glaciation and Diluvial Theory in South India.[74] Agassiz and Buckland introduced this major geological theory in Great Britain. It postulated the existence formerly of permanent snow, ice and glaciers over a large part of the northern hemisphere. Newbold showed that this theory was already tested in Central Russia and South and North America. The huge landmass of India was yet to be studied,

> General Briggs, perceiving that India was silent, while Europe, parts of Asia and America in both hemispheres, were contributing to the general stock of knowledge on this head, applied to some of the local authorities in the east to lent their aid in eliciting information,...[75]

According to Newbold, the total absence of boulders or drift formation in South India, supported the general theory that the masses of drifting ice on approaching warmer latitudes melted on their sides and surface and discharged their rocky freight long before reaching the equator.[76]

In the glaciers of the Himalayas Messrs. Schlagintweit found evidences which questioned the existing 'glacier theory' developed from studying the

[73] "Note on various Fossils sites on the Nerbudda; Illustrated by Specimens and Drawings", *JASB*, Vol.VIII, 1839, p.150; "Discovery of a Bed of Fossils (Marine?) Shell on the Table Land of Central India", *JASB*, 1833, Vol. II, p.376.
[74] Captain Newbold, "On the Alpine Glaciers, Iceberg, Diluvial and Wave Translation Theories; with reference to the deposits of Southern India, its furrowed and striated Rocks and Rock Basins with a Plate", *JASB*, 1845, Part-I, Vol. XIV, p. 87.
[75] *Ibid*, pp.87-89.
[76] *Ibid.*, p. 217-224.

Alpine glaciers.[77] In similar fashion several researches on various rocks and minerals were undertaken to extend European theories here. Researches on gypsum in the Indo-Gangetic tract of mountains, diamonds in Panna, Bundelkhand, and the Deccan trap were all attempts to examine specific metropolitan theories.[78]

Lambton's trigonometrical surveys were extensions of similar surveys by Europeans elsewhere. The survey in England under Colonel Mudge was undertaken to obtain a correct plan of the island of Great Britain. The members of Swedish Academy were likewise conducting research in northern Europe. These researches, along with those in India would provide, Lambton conceived, "The most extensive and most accurate data hitherto obtained for determining a question of great importance on physical astronomy, viz. the dimensions and the figure of the earth."[79] Similarly botanists and zoologists in India were involved in Linnaeus' project of organizing species into a coherent table.

In the 1830s William Whewell, who a famous scientist in England in a letter to *JASB* introduced his global scheme of determining the tidal variations along the coasts of the earth.[80] He provided suggestions for those who had the opportunity to make or collect observation on the tides at their place of residence. A few years later he published another memoranda in *India Review* for the same purpose.[81] Different people in various parts of the world took up these

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[77] Adolphe Schlagintweit and Robert Schalagintweit, "Report on the Progress of the Magnetic Survey of India and the Researches connected with it in the Himalayan Mountains from April to October, 1853", *JASB*, Vol.X, 1856, Part-I, p.124.
[78] J.D. Herbert, "Notice on the Occurrence of Coal, within the Indo-Gangetic Tract of Mountain", *A.R.*. Vol.XVI, 1822, pp.397-408; Cautley, "On the Gypsum of the Himalayas", *JASB*, Vol.I, 1832, pp. 289-296; James Franklin, "Diamond Mines of Panna in Bundelkhand", *A.R.*,. Vol. XVIII, 1830, pp. 100-122; Rev. S. Hislop, "Geology of the Nagpur State", *Journal of the Bombay Branch of the Royal Asiatic Society*, Vol.IX, 1853-54, pp. 58-76.
[79] Lambton, "An Account of the Measurement of an Arc. on the Meridian, Comprehended between the Latitudes 8°9'33"39"'and 10°59'48"93"' North, being a Continuation of the Grand Meridional Arc Commenced 1809, and extending to 14° 6'9" North", *A.R.*, Vol. XII, 1818, p.3.
[80] W. Whewell, "Semimenstrual Inequality of the Tides. Extract from a letter", *JASB*, Vol.IV, 1835, pp. 517-518.
[81] Whewell, "Memorandum Respecting Tide Observation", *I.R.*, Vol. III, August 15, 1838, pp. 303-335.

suggestions. Mr. J. Dias studied the daily tides at Singapore from 1st September 1834 to 31st August 1835. Lieut. Siddons had started his studies of tides at Chittagong. Many others like W.T. Loius of Malacca, Mr. C.B. Greenlow (Secy. of the Marine Board) from Balasore, Dr. Barrister at Madras, M. Bedian from Pondicherry, Sir. R.W. Harton from Bombay sent their reports to fulfil the project.[82]

In terms of organisation to the metropolis loomed large on the periphery. Research institutes like the Botanical Garden in Calcutta was built closely following the pattern of Kew Garden of London. The scientific journals too were modeled on the European ones. Corbyn's *India Review* drew its inspiration from the *Records of Science, Philosophical Journal. The Mechanic's Magazines* and the *Repertory of Invention and Art* etc.[83]

The emergence of the journal *Gleanings in Science* was in response to the changing orientations of the metropolitan scientific research. The 1830s saw the emergence of the Declinists in Britain pressing their case against the research organisation of Royal Society. The most important figure among them was Charles Babbage who argued that the Royal Society's amateurish character of science had contributed to its decline vis-a-vis continental science.[84] He showed that the liberal membership patterns of Royal society led to a situation in which a majority of members were amateur gentlemen. In contrast to that members in the French and Prussian academies needed to have outstanding scientific achievements. James Herbert (a scientist in colonial India) launched his *Gleanings in Science* around the same time sympathising with Babbage's critique. He asserted that *Gleanings* would be a purely science journal ideal for serious men of science.[85] He also reviewed Babbage's book and suggested that

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82 J. Dias, "Daily Register of the Tides at Singapore from the 1st September 1834 to 31st August 1835, inclusive", *A.R.*, Vol.XX, 1836, pp. 201-203; Whewell, "Memorandum...", p.305.
83 *I.R.*, Vol. I, 1836, p.4.
84 Babbage, *Reflection on the Decline of Science in England*, 1830, August M. Kelley Publishers, Reprint, 1970.
85 Herbert, "Preface", *Gleanings*, vol.II, 1830, pp.V-VII.

the Asiatic Society suffered from the same problems that Babbage had identified for the Royal Society.[86] If the high tides of amateurish science of the Royal society had influenced the research orientations of the Asiatic Society in the 1780s, the critique of that in Europe had launched a similar movement in India - in either case the metropolis thus getting confirmed. The other attempt to initiate a professional attitude was through the various committees like the Physical Committee. I would show in the next chapter while the larger commitments of the Asiatic Society did not ultimately produce a re-orientation of scientific organisation under the Asiatic society.

But this is only half the story. If the metropolis was seeking to instruct and shape scientific researches in the colony, it was simultaneously questioned and challenged through the periphery's research experiences. I have already shown how geographical Euro-centrism had been questioned in the peripheral researches and the extent to which the individuals at the periphery enjoyed a creative space. These were instances when the scientific knowledge was undergoing hybridization in the colonies. There are two important points to be made here. Firstly, this critique of Euro-centrism, and the creative space available to individual scientists was actually on the agenda of metropolitan project where western science was establishing itself through various ways of explaining the natural world of the earth. The critiques and creativity must both seen as a part of the imperialist enterprise. Secondly, there is the question of how instances of peripheral creativity ultimately shaped the nature of western science. How far were they accepted and rejected by the scientific elite of Europe?

There has been some discussion on the question of the extent of influence that the knowledge collected from the periphery had on the metropolitan knowledge. The earlier writings of Donald Fleming and George Basalla looked upon scientific research in Australia and America from a centralist metropolitan

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86 *Ibid.*

viewpoint.[87] They represent scientific work in the colonies as simple data-gathering by 'second-rank academics', who carried through assigned tasks. The writings of Edward Lurie, A. Hunter Dupree, I. Bernard Cohen and particularly Roy MacLeod on the other hand stressed the scientific genius of colonial personalities.[88] However, mere emphasis on the scientific creativity in the periphery misses the point in the metropolis-periphery epistemological equation. Scientific activities in the periphery were admittedly creative and hybridized. But how far did such instances of creativity actually influence or shift European metropolitan scientific paradigms?

The issue is extremely complicated as it involves the important question of the nature of growth of scientific knowledge. Debates on the influence of colonial knowledge on the metropolis must take into account whether research in the colonies led to any degree of transformation in western scientific knowledge whether there was any paradigm shift in any sense of the term, or whether research merely affirmed and elaborated on existing knowledge.[89]

As Kuhn has suggested the acceptance or rejection of a new theory depends on the consensus within the scientific community. It is in that context that the primacy of the metropolitan scientific community on the shifts in

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[87] Donald Fleming, "Science in Australia, Canada, and the United States: Comparative Remarks", *Proceedings of Xth Congress of History of Science*, Ithaca, 1962; George Basalla, "The Spread of Western Science", *Science*, Vol.156, 1967.

[88] Edward Lurie, "An Interpretation of Science in the Nineteenth Century", *Journal of World History*, 10, 1966-67; A Hunter Dupree, "Science in America-A Historian's View", *Ibid*; I. Bernard Cohen, "Some Reflections on the State of Science in America During the Nineteenth Century", *Proceedings of the National Academy of Sciences*, XLV, 1952; Roy, M. MacLeod, "On visiting the 'Moving Metropolis': Reflections on the Architecture of Imperial Science", *Historical Records of Australian Science*, 5, 3, Canberra, 1982.

[89] While discussing these one must take into account the debates between Kuhn, Lakatos and others on the role of criticism in existing scientific knowledge and theories. See the various articles of Alan Musgrave and I. Lakatos (eds.), *Criticism and the Growth of Knowledge*, CUP, 1978. The arguments are engendered in a single point, Lakatos and others arguing criticism advances knowledge by sophisticated falsification Kuhn arguing that criticism of existing knowledge remains rooted to the premises of the existing scientific paradigms and only strengthens the paradigms by finding newer ways of coming to expected conclusion. A 'paradigm shift' occurs only when such criticisms cannot be explained by the paradigm thus causing a 'crisis'.

scientific knowledge must be assumed. I will give an illustration of the acceptance of a very prominent theory developed in the periphery - J.N. Pratt's geodetic theory to illustrate my point. His researches were a part of the growing interest among the scientific community regarding the depth of the earth, the density of the earth and the gravitational effects on the surface. The interest was also on the shift of the gravity at various levels of the surface of earth. Pratt attempted the surveys at the base of the world's greatest mountain system the Himalayas during the first geodetic survey of the great Arc of the Meridian in India. He found that due to the great irregularities of the surface in terms of the mountains, the plains and long stretch of ocean till the South Pole, the plumb - line here hung northerly of the true vertical.[90] Pratt demonstrated that this shift was observable at other stations in the country.[91]

What interests me here is that Pierre Bouguer a century earlier had worked in yet another peripheral area, in the Andes of South America. He had observed similar phenomena.[92] But his findings did not receive much attention within the scientific community. Pratt was fortunate because by his time, the effects of topographic features on the plumb line, were better understood. Pratt had much better topographical information with which to explain his findings. He explained the deviation in terms of a thick solid crust of the earth from where the mountain drew their mass by an extension and small expansion of the matter in those lower region, causing the deviation in the density.[93] This was in opposition to the contemporary explanation suggested by of G.B. Airy whose work in English mines had convinced him that a thin solid crust. He explained this phenomena in terms of a hydro-static equilibrium.[94] While Airy's ideas continued

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[90] Pratt, "On the Attraction of the Himalayan Mountain Ranges and of the Elevated regions beyond the plumb line in India", *Transaction of the Royal Society of London*, Vol. 145, 1855, pp.53-100.
[91] Pratt, *Figure of the Earth*.
[92] Hall, *Op.cit.*, p.271.
[93] Pratt, *Figure of the Earth*.
[94] Airy, "On the Computation of the Effect of the Attraction of Mountain Masses, as disturbing the Apparent Astronomical latitude of station in geodetic surveys", *Transaction of the Royal Society of London*, B, 145, 1855, pp.101-103.

to be popular among geologists, Pratt's theory received acceptance among the physicists like William Thomson whose geo-magnetic studies of 1863, showed that the hypothesis of complete internal fluid was untenable. The later developments on ideas of solid and fluid state gave rise to the idea that some materials can act as either one or the other, depending on the time scale of application of the deforming forces. This illustrated that the two theories were actually not in contradiction to each other.[95] This finally led to the general acceptance of both Pratt's and Airy's theories.

This one example shows the complicated route a peripheral experience took to gain acceptance in the metropolis of science. Thus the evaluation of peripheral scientific research would require a detailed analysis of the politics, positions and status of contemporary metropolitan knowledge. Without such an analysis of the metropolitan knowledge the argument can be reduced to either centralist or an over-glorification of colonial enterprise. Such an analysis is beyond the scope of this paper. What I wish to point out at this juncture is the strong link between Europe and its colonies, the equation of power that existed between the 'metropolis' and 'periphery'.

It is true that in the ultimate instance, both the Indological and the scientific projects were metropolitan European projects. Bernard Cohn has suggested that the discovery of India's past "was an European project , the end being to construct history of the relationships between India and the West, to classify and order and locate their civilization on an evaluative scale of progress and decay."[96] But science due to its institutionalisation in that metropolis and for its own universalistic claims had to conform to that metropolis much more closely. The Indological project could enjoy a certain degree of autonomy from that metropolis.

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[95] Hall, *Op.cit.*, p.272.
[96] Bernard Cohn, "The Command of Language and the Language of Command", in Ranajit Guha ed. *Subaltern Studies 4 ; Writings on South Asian History* ,OUP, Delhi ,1985 , p.315.ssss

CHAPTER - 2

The Tragic Quest

In the last chapter we have seen how science as a metropolitan European project sought to explain and understand a peripheral world. To appreciate scientific researches in colonial India, we have to understand the peripherality of such pursuits, in spite of its instances of high creativity, liminality and originality.

Yet the equation was not as simple as the metropolis-periphery relationship would seem to indicate. Creative work when perceived as such does not accept the terms of peripherality. It articulates itself in metropolitan terms, as a search for truth and the extension of the boundaries of knowledge. Moreover, Asiatic Society sought to institutionalise itself and scientific pursuits in the periphery clearly in metropolitan terms. Such orientations created certain tensions, which is the object of my study in this chapter.

The Metropolis in the Periphery

When he had organized the Asiatic Society, Jones had hoped that it would become a centre for the study of the nature and culture of Asia. The model of the enlightened institution for him was the Royal Society of London. He drew encouragement from the fact that even the Royal Society was at the beginning only a meeting of a few literary friends at Oxford.[1] He imagined India as the centre with the entire Asia encircling it from all sides. The Society located within this `centre' would become the confluence of ideas, much like the

[1] "Discourse", pp. x-xi.

institution of Europe, "...it will flourish if naturalists, chymists, antiquaries, philologers, and men of science, in different parts of Asia, will commit their observations to writings, and send them to the President or the Secretary at Calcutta..."[2]

Such centripetal aspirations were logical, given that the Asiatic Society was the first institution involved in Oriental studies located within the Orient. But this aspiration also conditioned on similar lines the role of the Asiatic Society in organizing and influencing scientific research within Asia. From the very beginning the Asiatic Society patronized and encouraged scientific researches in India and elsewhere in Asia. The Physical Committee was formed with the

> ...thought that they would be more likely to attract the attention of the readers to whom they are chiefly addressed, as individuals engaged in scientific pursuits, that if they were associated with matters which are more especially addressed to literary men, as to the general readers....It was principally with the hope of collecting and recording with precision, facts, that this class has been established. Scattered as are our countrymen in the East over so large a portion of the surface of the earth as yet unexplored by science, the most common observer can hardly fail to notice a phenomena that may be important for the purpose of Physical Research,...
>
> Few apparently as are the labourers in this vast field, it seems but little understood how competent these few are to make the most valuable additions to our knowledge. The physical class hopes to encourage the spirit of enquiry by the assurance that the labours of the observer will be no longer in vain.[3]

The response that the committee received was overwhelming. Within a year materials were ready to fill 266 pages of a volume and furnish twenty maps, plates and charts. These formed the first part of the eighteenth volume of the *Researches*.[4] The subjects to which the attention of the Physical Committee

[2] "The Introduction", p. iv.
[3] *A.R.* Vol. XVIII, 1832, p.ii-iii.
[4] *Ibid.*

was principally directed were zoology, botany, meteorology and mineralogy in Asia. Many scientists took to different disciplines to inspire further researches. Reverend R. Everest ventured into the field of fossil geology, an unfamiliar field for him, only to "induce others to join in a pursuit".[5] Thomas Thomson's study of Herbarium of the Calcutta Botanical Garden had similar intentions:

> I bring this subject before the Asiatic Society therefore with a double object. I wish in the first place to make known the nature and extent of the Herbarium belonging to the garden, and in the second by means of the Society and the Journal, to bring to the knowledge of botanists in all parts of India, the assistance which is in their power to render in furthering the progress of a work, to make available to the students of Indian plants information scattered over a thousand detached works, and therefore only accessible to the professional botanist.[6]

The Asiatic Society also tried in its modest ways to grant recognition to individuals working in India. It gave a public recognition to Dr. Spilsbury, a geologist, for his services. Other members made a subscription for a portrait of Spilsbury that was to be displayed at the Society office.[7] Various journals were published to acknowledge the contributions of such scholars and also to provide encouragement and information to others. The *Gleanings in Science* was published for sometime from 1829. Its aim was to encourage scientific researches in India and elsewhere,

> It was thought that by establishing the practice of communicating to one another the various difficulties occurring in our pursuits of any enquiry, the new views which might strike us, or the criticism or detection of errors which might be forced on us in our references, a feeling might be created, which would tend, in some measure, to assist this effort, while to the student, the practice might afford an opportunity of obtaining information which he would otherwise seek in vain. It was thought, in fact, that by showing to the scientific community of India, small as it is, their own strength, and by suggesting and supporting a combination of effort, the apathy and

[5] *A.R.* Vol. XIX, 1839, p.107.
[6] *JASB*, Vol.XV, 1856, Part-I, p. 406.
[7] *JASB*, 1855, vol. XXXIV, p.171.

> indolence which are the bane of our Indian clime, might be in some measure counteracted.[8]

Besides the *Gleanings*, *Asiatic Researches* and *Journal of Asiatic Society of Bengal*, many new journals were published by enthusiastic members of the Asiatic Society. Frederick Corbyn started *The India Review and Journal of Foreign Science and the Arts* in 1836, John McClelland published the *Journal of Natural History* in 1840. Another such journal was the *Journal of Physical Committee*. Each of these had their specific fields of interest and research. Corbyn's journal had with two aims. First, to publish various researches being conducted in Europe which would inform scholars in India of the latest scientific developments in Europe. Second, to awaken and promote interest in research among the Europeans within the country which would, they thought, lead to the prosperity of India,

> We considered ourselves justified in stepping forward, humble as our pretensions were, to prove the utility of a Journal exclusively devoted to the review of works on science, embracing foreign science and arts and by showing the extensive influence which their dissemination must necessarily have in promoting the welfare of this country, and laying open those resources of knowledge which at all times have formed the basis of national power and prosperity, endeavour to awaken a general spirit of research...[9]

The Asiatic Society gave these men the scope to express themselves, to engage in a scholarship hitherto indulged only in Europe. Naturally, they saw the institute as their only means of being acknowledged for their scholarship. In the 1830s when geological researches were quite popular under the Asiatic Society's guidance, a proud scientist wrote:

> We have now before us two volumes of the transactions of the physical class, one for 1829, the other for 1833, replete with the most valuable geological intelligence, and we bast in the face of the scientific world in Europe that they are worthy of a prominent place in their transaction

[8] *Gleanings*, Vol.I, 1829, pp. 6-7.
[9] *I.R.*, Vol.I, 1836, pp.3-4.

> of the physical class for proof in the papers of Voysey, Herbet, Everest,.... We publicly renew our belief that if any mineralogists were to visit the society's rooms now, and view the specimens in mineralogy,...they would receive a full and satisfactory proof that much has been done in this department.[10]

Likewise, they had began to communicate widely with scholars in other parts of Asia, even Europe, about scientific knowledge. They received specimens from them and thereby enriched their museum. Specimens of rocks and fossils were exchanged with museums at Berlin,[11] St. Petersberg and Denmark.[12]

The appeal in 1830 to the government for funds for the museum expressed the vision the scientists had for the Society in the realms of science. It was the articulation of the dreams of the scientific community in India to be able to stand in the same line with the institutions of Europe to accumulate specimens from all countries around it, as the metropolitan institutes did. The following passage illustrates my point:

> The Asiatic Society, or it may be allowable to say the metropolis of British India, has had the germs of a national museum as it were planted in its bosom. As in *Paris* a new era was opened in the history of its great museums, the Jardin 'des Plantes, through the discoveries of extinct and wanderous animals forms exhumed from the rocks on which the town was built, and which required all the adjuncts of comparative anatomy for their investigations even by the master hand of the great Cuvier; so in *Calcutta* through the magnificence of a few individuals and the developments of fossils deposited in various parts of India hitherto unsuspected, we have become possessed of the basis of a grand collection, and we have been driven to seek recent specimens to elucidate them. Our desire has been warmly recorded by all who have enjoyed the opportunity of contributing; from *China*, from *New South Wales*, from the *Cape*, and from every quarters of the Honorable Company's possessions, specimens of natural history of

[10] "Review", *I.R.*, Vol.I, 1836, p. 154.

[11] *Journal of Bombay Branch of Asiatic Society*, Vol. I, July 1844. pp.87-89.

[12] Ray Desmond, *India Office Library and Records: The India Museum, 1801-1879*, OUP, 1979, p.59.

> mineralogy, and geology, have flown in faster than they could be accommodated,...[13]

Such centripetal aspirations, which were so logical in the Orientalist project spelled contradictions in the realm of science. Contemporary science was clearly metropolis-oriented-philosophically and in terms of sheer infrastructure. The members of the society, while at the periphery of scientific research, aspired for a metropolitan status for the Asiatic Society. In the years to come it and its members suffered from the strains of this contradiction.

The scientists, drawing strength from their liminal experiences and bolstered by an institution with metropolitan ambitions, articulated their work in metropolitan terms. Their researches claimed to make fundamental contributions to scientific knowledge.

Sir William Jones demonstrated one instance of how the association with the Asiatic Society and the Orientalist project could prompt original formulations in scientific knowledge. While working on Indian botany, he suggested that the Linnuaean classificatory scheme must be changed with the help of Sanskritic taxonomy for a proper understanding of Indian flora.14 He argued that for,

> Some hundreds of plants, which yet imperfectly known to European botanists, and with the virtues of which they are wholly unacquainted grow wild on the plains and forests of India -- The *Amarcosh, Dravyabidhana* and other texts could provide all the information and nomenclature needed to incorporate them into modern scientific knowledge.[15]

He wanted to arrange the indigenous classificatory systems into a modern taxonomic scheme. In another paper Jones had stressed that the

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[13] *I.R.*, Vol.II, Nov.15, 1837, pp. 519-520.
[14] Jones, "The Design of a Treatise... on the Plants of India", *A.R.*, Vol.II, pp.270-276.
[15] *Ibid.*, p. 270.

discovery of Indian names for these plants would open up the world of allusions in Indian poetry to its nature and the virtues of Indian physicians.16 This last instance shows how the Orientalist project sought to bring about new cultural elements within western science. It also demonstrates the creative potentialities of such experiences.

Other individuals, although lesser known than Jones, also consistently claimed fundamental status for their discoveries.

John Warren, who investigated the effects of terrestrial refraction in Mysore, argued that his researches exposed some of the problems of existing theories developed in the northern latitudes of Europe. He suggested modifications:

> But, may not the laws of refraction be materially affected by gravity, and other unknown causes, as to vary in different parts of the globe, and that theory which obtain in high northern latitudes fail in tropical regions? Indeed, the irregularities which of late have been detected in the declinations of certain stars, which, though unobserved in `England', are powerfully felt in these climates, sufficiently show how much we have reason to suspect an effect on the sort, and must evince the expediency of obtaining corresponding experiments in different latitudes, for, it is obvious, that even to ascertain any deviation in a system, perhaps too generalized, might be attended with incalculable advantages to science...[17]

Francis Balfour, a little known medical officer who worked on the Sol-Lunar influence on fevers, helped by the tropical conditions and by encouragement from the Asiatic Society, had interesting results to report. He combined his own and various other observations and he was able to establish a strong link between paroxysms of fever and the periodical changes that take

[16] "Botanical Observation on Selected Indian Plant", *A.R.*, Vol.IV, pp. 231-303.
[17] "Transaction of the Asiatic Society: An Account of Experiments made in the Mysore Country, in the year 1804 to investigate the Effects of Terrestrial Refraction", *A.R.*, Vol.9, 1811, pp. 2-3.

place in the power of Sol-Lunar attractions. Balfour ended his paper with some pride and confidence:

> Having discovered the laws of febrile paroxysms, and having marked their course and periods in a manner that was never explained or done before, I conceive that I have been able to unfold, a history and theory of fevers entirely new; consistent with itself in every part, and with the other appearances of nature; perfectly comfortable to the laws discovered by the immortal Newton, and capable of providing important improvements in medicine and meteorology.[18]

Maritime researchers in India had observed that the tropical region had a peculiar wind pattern. The early navigators' and travellers' accounts often directly or indirectly spoke of the violent storms of the tropics as 'whirl winds'. Gradually scientific attention was focussed on the phenomena. Henry Piddington gave a final shape to all the observations and scientifically defined the storms through his detailed studies over many years. He coined the term 'cyclone' for these storm and wrote several books on the phenomena.[19]

In 1829 J.D. Herbert through by his researches in the Indo-Gangetic tract of mountains on occurrence of gypsum challenged the existing theory that gypsum formation was always of the primary age. The occurrences of gypsum in the particular areas of the Himalayas showed the more general occurrences of this rock. In a post-script to his article, Herbert mentioned the recent findings of M. Brochant of gypsum in the Alps, which confirmed his theory.[20] In 1832, Capt. Cautley too wrote a note on the gypsum of the Himalayas, where he argued along similar lines. He claimed that the findings in the Himalayas prove

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[18] Balfour, "Observation.", p.29.

[19] Piddington, *The Horn-Book for the Law of Storms; For the Indian and China Seas*, (Calcutta, 1844); *The Sailor's Horn-Book for the Law of Storms: being a practical exposition of the theory of the Law of Storms, and its uses to mariners of all classes in all parts of the world, shown by transparent storm cards and useful Lessons*, Smith, Elden and Co., London, 1851. But it was his "Memoirs on Storms which was the most important contribution to the field of Indian Meteorology ad Oceanography. They came out regularly in *JASB* from 1839.

[20] J.D. Herbert, "Notice on the Occurrence of Coal, within the Indo-Gangetic Tract of Mountains", *I.R.*, Vol. XVI, 1828. pp.397-408.

that gypsum can no longer be entitled to a place either in the primary transition or secondary classes, but must be considered as an adventitious formation common to all ages.[21]

At Mysore Lieutenant Henry Kater in 1810 was faced with a common problem in colonial India, that of lack or inadequacy of instruments. He solved it by developing a hygrometer from a specie of grass found in the neighbourhood. He came across this grass quite accidentally and found it to be extremely sensitive to moisture. He claimed that hygrometer was extremely suitable for registering micro-changes of moisture in the atmosphere.[22] Kater confidently claimed that this hygrometer was more sensitive than anything hitherto developed:

> This grass appears to be far superior to any other hygrometric substances, hitherto discovered. In the `Encyclopedia Britannica' the scale of Sausser's Hygrometer is said to consist of 400 degrees or rather more than `one' revolution of the index; the Hygrometer here described makes eleven or twelve revolutions,...[23]

It was not the uniqueness of the tropics alone that facilitated creativity and optimism about their work. Dr. Tytler claimed that his discoveries in Electro-magnetism were made simultaneously with, if not before, those of Faraday. In a letter to the *Calcutta Courier* he quoted one of his previous correspondences to the same journal. It, he claimed, had clearly showed that he had discovered it before Faraday. He quoted the previous correspondence and wrote:

> It is perfectly evident from the above extract, that *discovery of Mosotti* (on whose proposition Faraday based his research) and illustration of *Faraday* in reference to it, comprehend the identical doctrine, which has been inculcated in the series of letters addressed by me to the Editor of the *Calcutta Courier* on the subject of the *Electro-*

[21] Cautley, "On the Gypsum of the Himalayas", *JASB*, Vol., I, 1832, pp.289-296.
[22] "Description of a very sensible Hygrometer", *A.R.* Vol. IX, 1811, pp. 24-31.
[23] Kater, "Description of an improved Hygrometer", *A.R.* Vol.IX, 1811, p. 397.

> *magnetism*; although from the language of Faraday respecting the *attraction* and *repulsions*, it is apparent that his (sic.) as yet, wholly ignorant of the immense affect (sic.) relative to *Electrical action* upon every species of matter, which, through experimental enquiry, has been accumulated and established during the last twelve months at this station.[24]

In another communication Tytler in his characteristic confident style challenged Newton's theory of 'gravity' for rock formation. He proposed his own theory that `galvanism' while working through the medium of water, produced crystalliferous forms, which constitute the distinguishing characteristics of `primitive rocks' and is therefore responsible for the oldest masses existent in the earth.[25]

Dr. Tytler probably died within a year of making these claims. Unfortunately there is no evidence that his interesting propositions were followed up by others or even whether they reached the scientific community of Europe at all. Probably not. Such was the fate of most other claims as well. Tytler's career is that of a typical colonial scientist, who worked in an obscure part of India, silently carried on his projects, contributed to journals from time to time, occasionally made interesting discoveries and were emboldened enough to challenge the works of metropolitan scientists, but who died without receiving any form of recognition from that community. The claims for a fundamental status for their findings were made irrespective of the realities of the metropolis-periphery equation where their researches were ultimately located.

Whether their claims were scientifically valid or not is another issue. What comes through here is an element of tragedy in the way these men worked

[24] *I.R.*, Vol.II, No.15, 1837, p.544.

[25] "The Influence of Magnetic Geological Geometry upon the Science of Geology", *I.R.*, Jan. 1838, Vol.III, pp.620-621.

aspired for acknowledgement for their claims, and then disappeared. There was another factor that condemned them to obscurity.

Science and Colonialism

The Asiatic Society maintained an interesting relationship with the colonial government. To begin with, there was the idea of partnership with the government. When the Society was formed the members asked the Governor General Warren Hastings and the members of the Council at Fort William to be honorary patrons of the Society. Hastings was also offered the first Presidentship of the Society, which he declined, though he agreed to be a patron.[26] It was the Company officials who carried on the researches and constituted the core of the Society's membership. How did such an association shape the course of the relationship between science and state in colonial India? How far did this shape the orientation and scope for scientific research in colonial India?

Coal was an important colonial priority. Researches on coal were motivated by commercial purposes. Next to coal in the line of priority were iron and minerals like laterite, manganese and gold the deposits of which were studied by the scientists and which were the major interest of the colonial state. However the relationship was not entirely uncomplicated. It is true that many researches, which had commercial potentialities, were undertaken. The scientists had no problem in serving the government and often worked for it. Yet there was a search for a creative space, original research, seclusion and independence. Along with researches on coal deposits, the paleontological and rock formation studies of no commercial value for the colonial state were also carried out. These parallel orientations have to be appreciated.[27]

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[26] *A.R.*, Vol. I, 1788, pp.III-IV.
[27] These researches were not just "result-oriented" as some historians tend to argue. Robert A. Stafford, "Geological Surveys, Minerals, Discoveries, and British Expansion, 1835-71", in *Journal of the Imperial and Commonwealth History*, Vol.XII, May 1984, Number 3, pp.5-32;

For instance, Dr. Oldham, whom Deepak Kumar credits with the first systematic surveying of coal reserves, was also responsible for the study of the great sandstone formation of northern and central India, which he named the `Vindhyas'. He pointed out that these rocks were of the Cambrian age. This project was part of a larger European interest of comparing the age of the oldest rock formation in different parts of the world.28 He undertook these study along side his survey of coal deposits. It is these kinds of involvements, which suggest complications in the scientists' relationship with the colonial state.

It must be remembered that this was the period when the state and science largely remained two separate entities. They had very different goals and their interests met rarely. The close collaboration between the state and science was a development of the later colonial and postcolonial India. In this earlier period both were yet to realise the advantages of a mutual understanding.

This had to do with the orientations of science in this period. For the scientists, the practice of science was to be something pure, and independent of external influence. This attempt at maintaining a distance from the state and from politics was a practice in contemporary Europe. The rules of both the Royal Society in London and the Academy of Science in Paris (adopted quite independently) precluded political and theological discussions. An ideal neutrality of science was institutionalised from the start. Scientists in general across the western world had supposed themselves to be modest, disinterested, unassuming and absorbed in the study of nature for its own sake and for the good of humanity.[29]

The Asiatic Society modeled as it was on the Royal Society, had imbibed this philosophy. The members were aware that in the long term their

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Kumar, "Science, Resources...". They were knowledge-oriented pure researches as well.
[28] May meeting of Asiatic Society, 1856, *Centenary Review of the Asiatic Society*, p.37.
[29] See Gillispie, *Science and Polity in France at the End of the Old Regime*, Princeton University Press, Princeton, 1980; also Weld, *op.cit.*, p.350.

careers unfolded within that wider realm of science, whose terms had no necessary connection to the logic of colonialism. Their scientific papers were written for fellow members of the society. Their science too did not function in the public sphere.

The metropolis had structured the colonial scientists not only in terms of knowledge but also in terms of the culture of that knowledge. The history of the Royal Society in the late 18th and early 19th century is full of such evidences of contestations with the government for freedom in scientific research and a romanticisation of the spirit of discovery.[30] The members of the Asiatic Society too associated scientific research with such independence and romance. It is for this reason that we find in their writings a rhetoric of these concerns, which in a colonial situation becomes particularly poignant.

The romantic temperament of the Orientalist project, which had a strong introspective bent and a distrust for the chilly dogmatic of utilitarianism, had also helped to develop this logic of insulation in science although it did not share the Orientalist respect for tradition.[31]

These concerns shaped the course of science under the Asiatic Society. Corbyn for instance stated clearly that, their status of "seekers of truth" could not be sacrificed for the government's requirements, "We are not flatterers of the government. We do not believe we are expected to sacrifice truth by that dissimulating act of praising when praise is not due."[32]

The members wanted the Society to keep a distance from the state and never to let it become a government institute in spite of the financial and other

[30] Weld, *op.cit.*
[31] Although not talking of 'insulation', Rocher makes a very important point. She argues that knowledge (Orientalist) and government objectives were not always related and their relationship was not unidirectional. The Orientalist project had its own motivations and inspirations quite apart from colonialism. See Rocher, "British Orientalism...". The scientific project shared this spirit of society and had its own tradition of insulation.
[32] *I.R.*, Vol.II, No.15, 1837, p.519.

problems they faced in scientific research in an alien country. They were vociferous in defending the Society's independence. There was a strong reaction to a proposal to turn the Asiatic Society into a government body;

> We are unquestionably of the opinion that the less scientific institutions have to do with government, the better: such a connection would bring the noblest institution in a state of the most abject dependence and bondage conceivable. As for ourselves we ask for liberty, especially in a geological, physical, or any other scientific institution, and we should like to see always as we have seen at the Asiatic Society, men of authority and power take their seats only as members....[33]

Science was viewed as sacred. The appeal was for 'liberty', for freedom to pursue knowledge on its own terms. The spirit of freedom, the romance of pursuing 'truths', doing original research and being absorbed completely in the study of nature was expressed by McClelland when he wrote, "Patience, disinterestedness and self-denial, are characteristics of all those (who) would obtain a distinguished place in science,..."[34] In his imagination the reward was in the work itself, in the ability to make contributions to scientific knowledge, even from India. Recognition from the metropolis, he believed, would then follow . In their passion for this 'disinterested' research, some were even ready to sacrifice that much yearned for recognition if it proved to be a distraction. The editorial of *JASB* while lauding the award of gold medals to Cautley and Falconer, warned:

> We might expatriate upon the gold medals awarded by the London geological society to Messrs. Cautley and Falconer as a stimulus to our discoveries, but although it must be an encouragement to all to find their labours thus appreciated at home, we should blush to put such rewards in the scale against, or with, the *disinterested love of science*, which has done so much alone. We would suggest to Dr. S. (Spilsbury)

[33] *I.R.*, Vol.I, 1836, p.153.
[34] *I.R.* Vol.III, No.15, 1838, pp. 546.

> not to confine himself to gigantic specimens, but particularly to select from the mass of fragment, teeth of all sorts....[35] (emphasis mine)

This wariness of recognition from the metropolis was rare. Yet this one indicates , illustrates the nature of their commitment to their project. This commitment can also be traced to the nature of the projects that they undertook. To the extent that most of these were extensions of major European intellectual concerns, they promised little for the immediate necessities of the colonial state. Although the scientists were serving the Company, they rarely had any instruction from their authorities to undertake such studies. They were amateur scientists who worked on their own areas of interest. There are several such interesting studies on meteorology. These studies were carried out in India particularly because the scientists were of the opinion that India could make fundamental contributions to the discipline. Their research was not launched simply to exploit colonial wealth. Rather, a tropical country with all its environmental and physical potentialities was sought to be utilized for the enrichment of scientific knowledge.

Piddington's researches on storms, which would have obvious implications for navigation, were conceived by him as a scientific and humanistic project.36 In all his papers he failed to project the commercial value of his researches which probably explain why he never received any support and encouragement from the government. On the other hand, the colonial state itself was not too keen to promote scientific research. It is true that the government had interest in such researches and realized its commercial potentialities, but that was only after such studies had been carried out in this country by these men for over half a century. The fact that in the early half of 19th century the colonial government took little interest in scientific research can be shown from

[35] Editorial Note to Dr. G. Spilbury's "Notice of New Sites of Fossil Deposits in the Nerbudda Valley", *JASB*, 1837, Vol.VI, p.489.
[36] Piddington, The Sailor's.., p.325.

the fact that the Company's own scientific establishment, the Calcutta Botanical Garden, was "starved from want of funds".[37] We now shift to study the consequences of such orientations and ambitions in a colonial world.

Tragic Quest

Researching in a tropical country and working under the Asiatic Society led the scientists to a faith that they were contributing fundamentally to western science. The very organization of the Society gave them the illusion of a metropolis near them. This fired their dreams and motivated their researches. But somewhere in their minds the centrality of Europe was unquestionable. It remained the dominant metropolis, the real centre of fame, recognition and support, all of which were of great value to the scientists. Thus in spite of their aspirations for the Society, the colonial scientists always tried to draw the attention of European scientists to their work.

Given the pre-dominant Euro-centrism of their discipline and the peripheral status of these men to the metropolitan scientific community in the 19th century Europe such recognition for them and their researches was not forthcoming. From the pages of the Asiatic Society publications we have to dig out the few cases of metropolitan recognition which were always highlighted. A few, like Falconer, went back to England finishing their careers here and their contributions were recognized. Some of them became Fellows of the Royal Society of London. Recognition was forthcoming to researches on tropical health where European knowledge was yet vastly inadequate. The great stakes that the Empire had in its tropical dominions helped in the matter. Meteorological studies too attracted some attention, but the science itself never attracted the highest attention in Europe. Geology, the most important science of 19th century Europe was as yet completely centred on Europe, and to some

[37] Thomas Thomson, "Report on the Hon'ble Company's Botanic Garden", in *Selection from the Records of the Bengal Government*, no. 25, 1857, pp.62-65.

extent America. Geological knowledge of Asia was yet to break in a major way within the metropolitan discourse. Thus we have James Calder's complaint, as late as 1829, against the neglect of Indian geology by the metropolis,

> It is singular to observe that, while England is ever ready to engage in enterprises to explore the secrets of nature, even in her most inaccessible retreats in other parts of the globe, she should have shown such supiness and indifference respecting the Natural History of the eastern domination. In the colonial possession of other nation, the whole field of nature has been explored and described by scientific and enlightened travellers, whilst in India, it has been almost entirely neglected,...[38]

Some amount of acknowledgement for the individual scientists came to those who went to Europe and could draw the attention of the scientific community there to their work. Many went to Europe at an advanced age with failing health, and had little ambition left. Financially also they saved too little to carry on their researches there. Many could never go back and died in India. This is where they were faced with their first contradiction between their metropolitan illusion and the peripheral realities.

Indifference on the part of the European scientific community to their `original' work either led them to dejection or gave rise to a sense of bitterness towards their colleagues in Europe. John Nionetrer, an entomologist, in an interesting essay expressed his frustration.39 His paper shows the tensions the colonial scientists were suffering from. He begins very candidly, with the description of a new specie, `Ceylone Coleoptera'; "I little doubt that the following description of a new coleoptera will meet with anything but approbation from the entomological world at home".[40] But with the characteristic confidence and optimism of a colonial scientist he asserted,

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[38] James Calder, "General Observation on the Geology of India", *A.R.*, Vol.XVIII, 1829, p.1.
[39] "Entomological Papers - being description of new Ceylone Coleoptera with such observation on their habits as appear in any way interesting", *JASB*, Vol.XV, Part-II, 1856, p.381.
[40] *Ibid.*

> As, however, in spite of this anticipation of an ungracious reception I shall hardly desist from my purpose of publishing such descriptions here often, I may as well try to indicate this measure by setting forth the reason which induce me to consider the difficulties which beset the path of the entomological author in this country as not insurmountable.[41]

Nionetrer ridiculed the prejudice of the European scientific community towards research in the colonies;

> The objections raised against me will be these...It is next to impossible that an individual entomologist abroad should surround himself with this shapeless mass of learning and keep himself by this or other means so well informed of the science as not to be exposed to mistakes of one kind or another, but more especially to creating synonymy in attempting to work independently. It will further be said against me that not having the facilities and whole-some checks which arise from the diligent use of extensive and well named collections, not even having the gratification of a brother entomologists' means and opinions on doubtful cases, it will be impossible even to determine whether an insect be new or not and from these reasons (the resume will be) entomologists abroad should confine themselves to collecting and observing the habits of the objects of their attentions, but they should never go to print with matters as which it is an impossibility for ablest among them to be quite competent...[42]

Such a disparaging attitude created a deep sense of resentment among colonial researchers. They felt that they deserved a better treatment from fellow lovers of science particularly since they carried on their researches under more difficult circumstances. Nionetrer was convinced that scientists in the colonies could overcome the problems they faced;

> As to whether a beetle be new or not, I admit that in forming an opinion on this question the entomologist situated as above will have quite as much to be guided by certain fact...as by anything else, and I am forced to concede that under any circumstances almost it is totally impossible to arrive at an `indisputable certainty' either the one way or the other. This however, by no means excludes the possibility of his

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[41] *Ibid.*
[42] *Ibid*, p.382.

> forming an opinion with so much precessions as to enable him to pronounce on the matter with a very "high degree of confidence and all probability" in his favour. In attempting to come to a decision on this difficult point he will receive a first superficial idea from careful reflection on certain accidental circumstances such as size, scarcity, or other peculiarities of the insect in question. This idea, whichever way it may incline, will then either gain or loose in strength by diligent reference to his library, until at length, with a certain amount of fact and judgement, he will arrive at a result, which under such circumstances must carry much weight with it.[43]

He hoped that, the emphasis on extensive observation and surveys which was so typical to scientific research in colonies could provide vital knowledge to a scientist otherwise uninformed of the latest developments in Europe. However, scientists in the colonies also enjoyed some advantages: for instance, that of working in the tropical climates. Nionetrer argued that those working in Europe could never study tropical insects alive in its surroundings. This unique advantage, according to him, could help to overcome the infrastructural and financial obstacles faced in the colonies;

> As mentioned above, the tropical entomologist has a proportionate share of advantages to balance what falls to his lot of the contrary; one of the advantages which he has over his brothers at home is that he has an opportunity of seeing and studying alive, what can at home only be examined in a state differing more or less from that of life...[44]

Nionetrer ended with a powerful criticism of the scientists in Europe: both for their opposition to publish such researches and their failure to appreciate their fundamental contributions. He resented the attempts by metropolitan scientists to reduce his tribe to 'mere collectors'. What is expressed is a bitterness against fellow scientists and a colonial scientist's search for dignity and identity;

> For what is a mere collector? Let him display as much industry as possible, he is hardly looked upon as an entomologist, certainly as long

[43] *Ibid.*, p. 383-4.
[44] *Ibid.*, p. 385.

> as he is prevented from publishing anything, not as a scientific one. Now if such a man merely desists from publishing the fruits of his researches from want of resources to assist him to go creditably through such a task, if he suffers his collection to go out of his hands, because he is too true a lover of science not to see the credit, in a great measure due to himself, reaped rather by another...I say, that a man who acts upon principles like these finds himself not seldom disheartened in the prosecution of his studies under difficulties such as I have set forth. If, however, as I have endeavoured to point out, these difficulties can be overcome to a very considerable extent, is anything more natural that he should be the herald of his discoveries himself? Could anything be more unkind and ungenerous on the part of his scientific brethren at home, than to oppose and discourage him by this disapprobation?[45]

Thus the respect for the metropolitan scientists was complicated by relationships of conflict. The desire for recognition from Europe went along with a need to assert the legitimacy of scientific research in colonies.

The second contradiction was between their project and the colonial situation. Science for these men .was an amateurish engagement where an individual pursued the secrets of nature at his own leisure and will. But in the colonial situation these men as company servants, could pursue scientific interest only as and when their job permitted. The Company was not obliged to provide them that time as these researches promised little pecuniary gains. William Jones while setting up the Asiatic Society, realized this problem. He expressed it in his inaugural speech;

> .. a mere man of letters, retired from the world and allotting his whole time to philosophical or literary pursuits, is a character unknown among *European* residents in *India*, where every one is occupied either in the affairs of government in the administration of justice, in some department of revenue commerce, or in the liberal profession; a few hours, therefore, in the day or night can be reserved for any study that

[45] *Ibid.*, pp.384-5.

> has no immediate connection with business even for those who are most habituated to mental application.[46]

At a time when East was seen as a `career', pursuing research, outside the so-called career in commercial sectors, was difficult. Thus the lack of time and leisure from the compelling demands of the Company's services they felt, was a major problem for their work. As Jones stated very clearly some time later: "The greatest, if not the only, obstacle to the progress of knowledge in these provinces, except in those branches of it which belong immediately to our several professions is our want of leisure for general researches".[47]

He illustrated their situation through a very interesting analogy: "...and as Archimedes who was happily master of his time, had not `space' enough to move the greatest weight with the smallest force, thus we who have ample space for our inquiry, really want `time' for the pursuit of them..."[48]

The dilemma was obvious. India with its vast diversity provided the attractive `space' for research. Yet their occupation denied them the time to do so. For some, the lack of appreciation in this country made things worse. They worked in a country where the European `enlightened portion of would scarcely fill an English village. The incentives to do research were minimal. The editorial of the first volume of *Gleanings* expressed the feeling that the question of leisure was connected to that of recognition and appreciation for their work. In colonial India Europeans often did not find the leisure to do research because the hardships were immense and the rewards very meager. Thus few wanted to risk their spare time for such an uncertain pursuit.[49]

The other problem was directly with the colonial state, in its commercial orientation and lack of appreciation for scientific research. In their non-

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[46] "The Introduction... ". p.iii.
[47] *A.R.*, Vol.II, 1789, p.270.
[48] *Ibid.*
[49] *Gleanings*, Vol.I, 1829, p.vii.

utilitarian orientations of science, commerce posed to be a distraction. The colonial state's high commercial priorities, often at the expense of the patronage of science, was unacceptable to them. As one scientist grumbled, "...Why is not a similar indifference evinced in commercial and other occupation in which we see an energy and devotedness, which is not to be surpassed by speculators in any other part of the world?"[50]

The neglect of science was not perceived by them as the only problem of the colonial government's preoccupation with commerce. It tended to divert pure scientific researches into commercial direction as well. Corbyn wrote of one instance,

> We have some curious instances of this indifference towards science, which we have no doubt, will excite the surprise of scientific men in Britain and France. Dr. McClelland states on the authority of Dr. Buchanan, that when the natural and artificial production of Mysore were required to be known, he was directed to make esculent vegetables, cattle, farmers, cotton, pepper, sandal-wood, cardamoms...the chief object of his researches. Now we are sure it will be conceded even by the Honorable Company themselves in the nineteenth century, that the list savours more of import and export than the love and glory of science...[51]

There were other complains about the government's general failure to appreciate the real essence of scientific researches. The appointment of surveyors they felt, were more for political imperatives than for a true appreciation of the logic of surveys. In a discussion about the little information available about the physical nature of India, Corbyn characteristically pointed out,

> The British government, we lament to say, has never once to our knowledge afforded the least encouragement to men of science and learning to obtain information as to the physical structure of the

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[50] *I.R.* Vol.I, 1836, P.155.
[51] *Ibid.*, p.152.

> country. We look to the labours of a Moorcroft, Gerard and a Burns as sanctioned more for political purposes than those of science,...[52]

Thus it was not that the scientists did not have any expectations from the colonial state. They did expect patronage, which was not forthcoming. This gave rise to yet another kind of frustration and caused resentment. Henry Piddington, for instance, was upset that the government was unwilling to help researches on cyclones which posed a great threat to human life. He reacted against what he saw as the state's indifference towards both science and human life;

> As regards the government, we must leave them to their own sense of duty, which ought at least to teach them that such a science should not be neglected by them as it has hitherto been. For such supineness is a disgraceful neglect of their highest interest and one of their most sacred duties. What would Englishmen say to a foreign power which should fail to furnish the lights to a lighthouse gratuitously built up by poor, but jealous, men for the benefit of the whole world? The science itself must be true or false. Even if it is false as it has been shown to be true nothing but advantage can result to human knowledge in general from the facts which it has already registered and from those which it in future bring to light. If it is true it is utterly incomprehensible that ENGLAND, the first naval power in the world should with such knowledge within its grasp allow a vast amount of property to be put in peril and hundreds and thousands of the best and bravest of her children to be annually consigned to suffering or to death, just as the chance may turn out...[53]

Besides, the scientists were also frustrated by the government's complete failure to acknowledge the individual scholars and their discoveries - which, as we have seen, formed a crucial element of scientific activities in the periphery. The editorial of *India Review* on the eve of James Princep's departure to England had some sharp comments to make against the government;

> We had expected the very least, on the departure of such a man from these shores, where he had shone with such unparalleled splendour,

[52] *Ibid.*
[53] Piddington, *Conversations*, p.109.

> that some public testimonials would have been made by the government whose members acquainted with the progress of science and the immense benefit a state derives from its encouragement.[54]

The expectations of support are not to be confused with a desire for subordination. The government was expected to provide aid and encouragement to the Society's project, but it would have to respect its freedom and to distance itself from any advisory or directional role. It had to honour the objectives of the societies;

> We expect, and it is not unreasonable to expect, that government should come forward with the powerful arm of support, not only as refers to pecuniary assistance, but as regards its influence in obtaining for such societies all the aid necessary *to promote the object of their foundation.*[55] (emphasis mine)

Absorbed as they were in their romantic search for knowledge, they were insulated from the logic of the politics and economics of the state. They misconstrued the basic nature of the colonial state. They failed to realise that the colonial state with its overriding economic concerns would have little interest in patronizing such projects or ideologies. Insulated as they were from the colonial situation they aspired to the sort of recognition and patronage afforded by the European states in Europe. The reference by Piddington to England in block letters reflected his feeling of disbelief and shame at being treated in such a manner by this country. This is where they confounded their colonial situation with their metropolitan aspirations.

Their relative insulation from the colonial logic and illusions about the metropolis is also expressed in their admiration for France. In 1836, a review article in *India Review* remarked, "We have often thought that if France had been in possession of India, how science would have triumphed".[56] Similarly,

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[54] *I.R.*, Vol.III, Dec.15, 1838, p.480.
[55] *I.R.*, Vol.I, 1836, p.153.5-6.
[56] *Ibid.*, p.152.

that editorial which criticized the government for failing to appreciate James Princep, added; "Had France, where scientific men are so manifestly patronized owned James Princep, she would have laurelled his brow and sounded his glory to all the nations of the earth."[57]

France was heralded by men of science in Europe as the true patron to their course for its early patronage of science. Insulated from colonialism and disillusioned about their right to be patronized by state, the colonial scientists thus located the problem, erroneously, at the level of metropolis, i.e. France and England and not within the colonial logic. This fascination also reflects the `disinterestedness' that these scientists maintained even in a colony. What mattered to them was their work and the support which was crucial to carry it out, not where it came from. Science for them was a noble search for truth and beyond such geographical and national boundaries.

It was in their struggles against the colonial state and the search for independence that a deeper tragedy was involved. In our understanding of colonialism as a representation of the power of ideas and knowledge, the project of science was ultimately closely linked with that colonial state. Their understanding of the nature of this world, their new classificatory schemes indicate the control of a new knowledge and language over distant geographical terrain. Here even their paleontological studies had manifested themselves into deeper relationships of control and power. In their search for a 'rational', 'free', 'liberal' world and their subsequent critique of the state, these men had ultimately confirmed the hegemonic and coercive instrumentality of that state.

Not only colonialism, these men had failed to appreciate fully the shifting concerns of even metropolitan science. The 19th century saw an increasing professionalisation and specialisation in science in Europe while the Asiatic Society continued to cherish its amateurish status. The contradiction

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[57] *I.R.* Vol.III, Dec.15, 1838, p.480.

was in the Orientalist manifestation of their metropolitan science. Herbert's abortive efforts through *Gleanings* only indicated the tensions between these two orientations. In 183 the separate identity of *Gleanings* was merged into the more general *JASB.* Science under the Asiatic Society in 19th Century was a strange marriage between romanticism and utilitarian-professionalism. While science in the 19th century Europe was increasingly getting professionalised and associated to the productive machinaries of states, the basic inspiration for these men to study India's nature remained a romantic amateurish search. In its epitomisation of that spirit, the Asiatic Society's science was unable to go beyond that of the Royal Society. Its larger commitments towards the 'Orient' restricted the growth of professionalism in science under it. Such a status had become marginal even within India, with the growing influence of the Utilitarians and Anglicists in the 1830s who were challenging this romantic non-utilitarian pursuit of knowledge. The Asiatic Society in the 1840s had become an association for the 'defeated' Orientalists. Thus their science remained a zealous caricature in the periphery of a redundant metropolitan culture.

Most journals constantly complained of a lack of funds and subscriptions. They found it difficult to meet the expenses of printings and postage. Under such pressure it was increasingly difficult for these journals to maintain their commitment towards science. Compromises became necessary for survival. The publishers of *India Review* realized that a journal based solely on abstract branches of science in a country like India where the "British reformers and their descendants are comparatively few", had little chance of survival. It thus made a choice;

> It is principally on this account that we determined to blend with purely scientific matters, articles on the mechanical arts, and such other

> interesting subjects as regard improvement in manufacturers, commerce, agriculture...[58]

These 'interesting subjects' were included to sustain the main purpose of the journal to publish researches on 'pure' science. As the preface to the first volume continued;

> The grave philosopher and man of science may not delight in articles of the former description, but attending to our explanation, he would find that our object is to secure extensive circulation, tending greatly to support that portion of our work which is to be devoted to the latter articles which he desires to see,...[59]

One alternative to compromise was closure. *India Review* made a 'compromise', the others did not. The outcome was that most of them closed down after some time. Apart from the *JASB* none of these journals experienced a long life. Even *India Review* with all its attempts at survival could not last a decade. By 1840 the journal was facing severe financial crisis. The publication was stopped for one year in 1842 due to shortage of funds. It came to life in 1843 again, but with little hope of survival left. A note to the subscribers in that volume reflected a sense of dejection;

> The little encouragement afforded in this country to the publication of a work devoted to scientific and mechanical pursuits is in itself sufficient to deter any, but a warm lover of the cause, from such an undertaking as that we have endeavoured to carry on; but if to the "Plentiful lack" of literary and scientific aid we add, as in our care may, the lack of pecuniary means arising from the causes we have referred to it might excite less surprise were we now penning our own epitaph instead of an apology for coming to life again.[60]

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[58] *I.R.*, Vol.I, 1836, p.155.
[59] *Ibid.*
[60] *I.R.*, Vol.VIII, No.II, Sept. 1843, p.1.

The apprehensions about a total closure probably turned to reality quite soon afterwards because after the mid '40s' no further reference to the journal is to be found.

Financial crisis bothered the Asiatic Society and other institutions as well. Throughout the 19th century, the Society suffered from lack of funds. The condition of the Botanical Garden at Calcutta was even worse. Edward Blyth who was appointed as the curator of the museum of the Asiatic Society on a very small stipend never saw it increase throughout his service of 20 years.[61] His condition was pitiable and he was forced to ask for a raise to the Court of Directors of the East India Company. The appeal made no impact and he had to ultimate go back to England plagued by ill health, in 1862.

The tremendous strains posed by their difficult project comes through in the scientists' their writings. Between their expectations and the reality, between visions and the unfavorable conditions of work, they found themselves helpless in a colonial world. They had aspired to emulate the societies and researches of the metropolis: their project turned into a tragic quest in the periphery. John McClelland tells the story of Mr. Laidlow who was appointed as a geologist by the government but subsequently forgotten. It reflected the disenchantment many scientists were faced with:

> That such a case should ever have occurred, that an individual who surrendered his fair prospect of fortune and fame in his native land and at the expense of a small private fortune, perhaps, equipped himself for a task of vital importance to India, should be heard to complain of any want of liberality, calculated to induce him to relinquish his design, is more than can be conceived. Yet such would seem to have been the case. For some unfortunate reasons, it was deemed expedient to withdraw all pecuniary support from the gentleman who had entered so nobly upon the task above referred to, and thus abandoned in one of the most remote corners of India, a term of seventeen years have

[61] *JASB*, Vol.XV, 1856, Part-I, p.234, Also see Stepher and Lee, *op.cit*, for biographical details.

> now passed over him, without the means of even transmitting his property to a place by this means to return disappointed and ruined to that home which they left under the brightest auspices. A deep sense of the injury sustained has destroyed his confidence in man, and suppressed the utterance of any complaint.[62]

Conclusion

The history of science in the colony was a history of ambitions, beliefs, frustrations and ecstasies. These feelings were common to scientific research, which scientists in the colonies shared with others working in similar projects elsewhere in the world. My discussion comes to an end by the 1860s, because subsequently the nature of scientific research underwent significant changes. In that period the government started taking a direct interest in scientific research and organized various research departments. The realization had come that science could play a more crucial role in the colonial state. In that context the Asiatic Society gradually lost its ground as a scientific institution. In an atmosphere of increasing collusion of the scientists with the state, the Society became irrelevant to scientific discourses, and was unable to provide any new direction. The Asiatic Society from this time came to be identified as a predominantly Oriental institute which is how we perceive it today.

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[62] *I.R.*, Vol.I, 1836, pp. 155-6.

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 organized 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

[1] Cyril Fox, "Presidential Address', *Transactions of the Mineralogical and Geological Institutes of India*, (Henceforth, *Transactions*), Vol. XXXI, 1937, pp. 14—19.
[2] *Ibid.*

have a specific function; that of surveying and locating coal and thus serving the interests of the colonial state.

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 realized 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[3]. 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.[4] 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.[5]

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

[3] *Hundred Years of Weather Service (1875-1975)*, Indian Meteorological Department, Printed by Deputy Director General of Observations (C & G.), Poona, 1975, p. 17.
[4] *Ibid.*
[5] Roy M. MacLeod, "Scientific Advice for British India : Imperial Perceptions and Administrative Goals, 1898-1923", *Modern Asian Studies*, Vol. 19, No. 3, 1975, p. 350.

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 research institutes, such as the School of Tropical Medicine in Calcutta and the Haffkine Institute in Bombay.[6]

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.[7] Here, Dalhousie, a staunch Tory and a utilitarian administrator played a crucial role.[8] 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.

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[6] L.L. Fermor, "The Development of Scientific Research in India upto the End of the nineteenth Century", *Year Book of Asiatic Society of Bengal,* Vol. 1, 1935, p. 12.
[7] Eric Stokes, *English Utilitarians In India,* Oxford, 1959, p.
[8] Suresh Chandra Ghosh, " The Utilitarianism of Dalhouise and the Material Improvement of India", *Modern Asian Studies,* Vol. 12, No. 1 1978, pp.97-110.

The other influence exerted on the colonial government was from the metropolitan scientific community, 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 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.[9] 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.[10]

Thus, science was sought to be re-organised 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, metropolitan factors. Regarding the impact of European ideas, Robert A. Stafford's works on De La Beche and particularly Murchison provide the basic

[9] See Robert A. Stafford's Works, "Geological Surveys , Mineral Discoveries, and British Expanse, 1835-71", *Journal of Imperial and Commonwealth History,* Vol. XII, No. 3, May 1984; also his book *Scientist of Empire, Sir Roderick Murchison, Scientific Explorations and Victorian Imperialism,* CUP, Cambridge 1989.
[10] Stafford, ' Geological Surveys", *Op.cit.,* pp. 16-19.

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".[11] 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 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 emphasized 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?

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[11] *Ibid.*, p. 23.

[12] Stafford , *Scientist of Empire,* pp. 203, 206.

[13] Deepak Kumar, "Science, Resources and the Raj : A case India", *Indian Historical Review,* Vol. 10, 1983-84; Also his book, *Science and the Raj, 1857-1905,* O.U. P., Delhi 1995 (1997), pp. 32-112.

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 universalism.

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.

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*

[14] Stafford, "Geological Surveys", *Op.cit., p. 10.*

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 the department from scratch.[18] Oldham felt hampered because it was almost impossible to recruit geologists in India as the subject was not taught in the country.[19]

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.[20] 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".[21] 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."[22] Neither

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[15] Kumar, "Science, Resources and the Raj *Op.cit.*, pp. 76-77..
[16] Fox, *op.cit.*, p. 21.
[17] *Ibid.*
[18] C.R. Markham, "*A memoir of the Indian Surveys*, London, 1871, p. 154.
[19] Deepak Kumar makes this point. See Kumar, "Science, Resources and the Raj", *op.cit.*, p.87.
[20] *Ibid, p. 73.*
[21] Thomas Oldham, *The Coal resources and Productions of India : Being Return Called for the Secretary of State for India*, Appendix V. Calcutta, 1867, p. 24.
[22] Valentine Ball, *Jungle Life in India on the Journeys and Journals of an Indian Geologist*, Thos. De La Reu & Co., London, 1880, p. 6.

was news from other parts of the empire very encouraging. Success eluded geologists in New South Wales, Tasmania and South Africa.[23] These early disappointments and Murchison's death in 1871 marked a lull in geological activities in England as well as in the colonies.[24]

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.[25] The GSI, in much the same manner as the Asiatic Society was interested in building up links with various scientific and geological societies and organisations throughout the globe and its publications were found in various libraries world wide.[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, an 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..."[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,

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[23] Stafford, "Geological Surveys", *Op.cit.*, p. 22.
[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.
[26] *Ibid*, p. 88.
[27] Ball, *op. cit., p. X*

> ...There are some kinds of special enquiry which can hardly be treated as matters of *routine*, and which requires more knowledge and judgment 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.[28] (Emphasis mine).

Therefore, official scientific works was seen as 'routine', a 'duty', divorced from questions of "knowledge and judgment", 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.[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.[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 pre occupations in the colonies, which they thought would marginalise scientific research.

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...[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

[28] H. F. Blanford, *Meteorology of India; being the second part of the Indian Meteorologist's Vade Mecum*, Office of Supt. of Govt. Printing, 1877, p.165.
[29] *Ibid.*
[30] H. B. Medlicott, "Note on the Preceding paper", *Journal of the Asiatic Society of Bengal*, (Henceforth, *JASB)*, Vol. XLVI, No. 1, 1877, pp. 11-13.
[31] Fox, "Annual Address", *Year Book of the Royal Asiatic Society of Bengal for 1942*, Vol. IX, 1943. P. 13.

> 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.[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 caliber, 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,

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32 *Ibid.*, p. 14.

33 Stafford, "Geological Surveys", *op.cit.*, p. 22.

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 was willing to accept the risk, nothing further could be done.[36]

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

[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 suffer or 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.
[36] J.A. Dunn, "Suggestions for the Future Organisations of India' mineral Industry", *Transactions*, Vol. 39, March, 1943, No.1, p. 8.

> 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.[37]

Geologists remained 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.[38] (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 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 metropolis, 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.[39] Viceroy

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[37] Quoted in Fox, "Presidential Address," *op.cit.*, p. 25.
[38] *Ibid.*
[39] Clive Dewey, "The Government of India's 'New Industrial Policy', 1900-1925: Formation and Failures" in K.N. Chaudhuri and Clive Dewey (Eds) *Economy and Society; Essays in Indian Economic and Social History*, OUP, Delhi, 1975, pp.215-250.

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.[40] 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'.[41]

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'.[42] In the hierarchical administrative structures of colonial India, bureaucrats enjoyed a lot of freedom in administrative initiative. The top echelons of 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 wining the Murchison Medal and Prize. After a period at South Kensington as assistant

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40 *Ibid. pp.* 223-224.
41 *Ibid.*, pp.219-222.
42 *Ibid.*, p.218.

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 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

[43] "Sir Thomas Henry Holland", *Records of the Geological survey of India,* (Henceforth *Records*) Vol. 11, part I, 1947, p. 232.
[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.

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 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".[48]

Holland also noted that most problems were caused by the scientific approach in colonial India, which was yet come to terms with applied science.[49] To Holland the problem started with the very definition of a 'scientist':

[47] T. H. Holland, "Presidential Address", *Transactions*, Vol. I, 1907, p. 32.
[48] Holland, "presidential Address", *Transactions*, Vol. II, 1908, p. 9.
[49] *Ibid* p. 11.

> 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...[50]

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...[51]

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 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."[53]

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'.

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[50] *Ibid.*
[51] *Ibid.*
[52] *Ibid.*, p.13.
[53] *Ibid.*

> ...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).

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

[54] *Ibid.*, p. 14.
[55] Holland, "Presidential Address", 1907, *op.cit.*, p. 32.
[56] *Ibid.*

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."[57] 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;"[58] 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 remodeling of such old ones as can be profitably worked under the influence of foreign competition.[59]

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 economics on the other.[60] Holland added to the category of most essential minerals chosen by Watt salt, coal, iron-ore and

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[57] *The development of the Mineral Resources of India* Education Society Press, Byculla, Bombay 1883, p.2.
[58] *Ibid.*
[59] *Ibid.*, p.7.
[60] George Watt, "*A Dictionary of the Economic Products of India* Vol. I, 1889, p. VII.

petroleum. His additions included gold, graphite, jadeite, magnetite, manganese, mica, rubies, salt-petre and tin.[61] 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).[62] 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 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

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[61] Holland "Mineral Production, 1898-1903", *Records,* Vol. XXXII, part I, 1905, p. 3.
[62] *Journal of Royal Society of Arts,* Vol. 59, May 1911, pp. 626-655.

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

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[63] Fermor , "Tables of Production, Imports, Exports and Consumption of Minerals and Metals in India", *Records,* Vol. LXVI, part 4, pp. 472-73.
[64] Holland, *The Mineral Sanction as an Aid to International Security,*Oliver and Boyd, London, 1935.
[65] "*The Mineral Sanction....* (Review)" *Nature*, July 27, 1935, Vol.136, p.124.
[66] Arranged by the Division for the Social and International Relations of Science of the British Association, *Nature*, September 26, 1942, Vol. 150, pp.364-366.
[67] *Nature,* Oct. 3, 1942 Vol. 150., pp. 395-6.

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]

Organizational 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]

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68 "Holland", *p. 237.*
69 *Ibid.,* p. 233.
70 Holland, "The Mica Deposits of India", *Memoirs* Vol. XXXIV, pp. 46-53,,78-82, 1902; "Preliminary Report on the Iron Ores and Iron Industries of the Salem District", *Memoirs of the Geological Survey of India,* (Henceforth , *Memoirs),* 1892.
71 *Transaction,* Vol. XV, 1920, p. 40.
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.[73] The government by 1899 had already changed the mining rules, which had created so much trouble earlier.[74] 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.[75] 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.[76]

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 peridoties 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.[77]

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

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[73] "Holland", p. 234.
[74] Vinay Bahl, "The Emergence of Large -Scale Steel Industry in India under British Colonial Rule, 1880-1907", *The Indian Economic and social History Review, (IESHR)*, Vol. XXXI, No. 4, 1994, p. 451.
[75] "Holland", p. 234.
[76] G.G. Jones, The State and Economic Development in India, 1890-1947: The Case of Oil", *MAS*, vol. 13, No. 3, 1979, pp. 369-370.
[77] Holland, "Presidential Address", 1907, p. 32.

Survey has no more right to 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 summarize 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]

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[78] Holland, "Presidential Address", 1908, p. 14
[79] *Ibid.*
[80] "Holland"., *p. 234.*
[81] Holland, "Presidential Address", 1908,.p. 16.

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 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.[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..,[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 metropolitan 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 metropolitan view that India should leave

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[82] *Ibid.*, pp. 32-33.

[83] Holland, "Presidential Address", 1908, p. 16.

pure science to Britain and concentrate on to the applications of science for colonial exploitation.[84]

Holland, however, had contradictions in his thought, which makes it difficult to fit him into the metropolitan imperial scientific discourse. Holland played a dual role, one that of a peripheral scientist working in colonial India and the other of a metropolitan statesman. 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 Metropolis 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.[85] 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

[84] See MacLeod, *op.cit.*, p. 360.
[85] Michael Adas, *Machines as the Measure of Man; Science Technology and Ideologies of Western Dominance*, Cornell University Press, Ithaca and London, 1989, pp. 141-143.

peripheral mineral obsessions with the metropolitan 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 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

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[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 in1945. 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. Andrew'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

mineral. He came to India thrice after resigning from the GSI. What is interesting is that in his journeys between the metropolis 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 is in this refusal of Holland, that the second contradiction between colonialism and univeralism becomes apparent.

Holland's first point of dissent from imperialist metropolitan 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.[88] 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 "patronizing".[89] 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".[90]

[88] MacLeod, *op.cit.*,
[89] *Ibid.* p. 359.
[90] *Ibid.*, p. 383. See MacLeod, for a detailed version of the conflict.

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.[91]

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 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

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[91] Kumar *Science and the Raj*, pp. 107-109.
[92] See p.96, above.
[93] Amitabha Ghosh, "Guru Jones - A Private Engineer and the Colonial Trap", *Indian Journal of History of Science*, Vol. 32, No. 2, 1997, p. 139.

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 civilized 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 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 civilization".[97] Having rejected the western model, India provided to Chatterton the scope for a unique 'experiment' of industrialisation without mechanization,

> ...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

[94] Viswanathan, *op.cit.*, pp. 60-63.For other individuals like Nicholson, see Viswanathan, *op.cit.*, pp. 63-69.
[95] Alfred Chatterton, *Agricultural and Industrial Problems in India* G.A. Natesan and Co. Esplanade, Madras, p.22.
[96] *Ibid.*, p.23.
[97] *Ibid.*
[98] *Ibid.*, pp.22-23.

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 was to complete the 'economic cycle' and develop chemical and metallurgical industries in India.[99] Elsewhere, he criticised GSI's earlier focus on coal and stressed the need to develop other minerals, particularly manganese.[100]

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 civilized community than gold and precious stones".[101] 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 utilization 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..[102]

Holland was also taking interest in other industries, dependent on geological knowledge including building materials, like stone, concrete and

[99] Holland, "Mineral Production 1898-1903", pp. 17-19, p. 62
[100] Holland, "Presidential address", 1908, p. 22.
[101] Holland, "General Report, 1903-1904", *Records*. Vol. 32, 1905, p. 159.
[102] *Ibid.*

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...".[103]

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 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.[104] 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.[105]

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 loosing 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

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[103] Quoted in "Quinquenniel Review of Mineral Production of India for the Years 1919-1923", *Records* Vol. VII, 1925, p. 329.
[104] Amiya Kumar Bagchi, *Private Investment in India 1900-1939.*, Orient Longman, (CUP 1972), pp. 420-5.
[105] *Ibid.*, pp. 50-53

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.[106]

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.[107]

However, Holland's project went beyond the British national and imperial 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".[108]

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[109]

[106] Bahl, *op .cit.*,
[107] Sunil Kumar Sen, *The House of Tata (1839-1939)*, Progressive Publishers,Calcutta,1975, p.43.
[108] *Ibid.*,
[109] Holland, "Mineral Production", *p. 62.*

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.[110]

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".[111] Stressing the case of manganese, he showed now the pattern of trade hurting Indian's interests,

> 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...[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

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[110] Holland, "Presidential", 1908, p. 22.

[111] Quoted in P.K. Ghosh, "Contribution of the Institute to the Mineral Industry of India", Presidential Address, *Transactions*, Vol. 53, April, 1956, p. 52.

[112] Holland, "Presidential Address", 1908, p. 51.

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 came to grief.[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 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 utilized also to turn our natural advantages to account in India.[114] (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 metropolis 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.[115]

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[113] *Ibid.*, pp. 23-24.
[114] *Ibid.*, p. 50..
[115] Kumar, "Science Resources and the Raj", p. 70.

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".[116] 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 sub-continent 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 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.[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.[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

[116] Holland "Address", 1908, p. 25.
[117] P.K. Ghosh, *op.cit.*, p. 50.
[118] W. H. Pickering, "Introduction", *Transaction*, Vol. I, 1907, p. 23.

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.[119]

In Pickering's ideas Holland saw the fulfillment 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.[120]

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.[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.

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[119] *Ibid*, p. 24.

[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 organization, 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", *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.

[121] P. K. Ghosh, *op.cit.*, p. 51.

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."[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 America which shows better average financial results than mining".[123]

Holland also put forward his agenda for technical education and vocational training among the British officials in India.[124] 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.[125] 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.[126] He pointed

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[122] Holland, "Presidential Address", 1907, p. 30.
[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
[125] P.K. Ghosh, *op.cit.*, pp. 19-20.
[126] *Ibid.*, p. 21.

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.."[127]

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.[128]

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".[129] 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 oppose government export policy when necessary and initiate mining and utilization of such products on a large scale.[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."[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,

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[127] *Ibid.*,
[128] *Ibid.*, p. 19.
[129] "Annual Dinner", *Transactions*, Vol. IV , 1909, pp. 74-75.
[130] *Ibid.*,
[131] *Ibid.*, p. 85.

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 coordination 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 mobilize mass support. The IIC, was a culmination of this growing pressure on the government to own up to the responsibility of industrialising India.[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 established in 1916.[133]

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".[134] To this was

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132 Bipan Chandra , *The Rise and Growth of Economic Nationalism; Economic Policies of Indian National Leadership*, 1880-1905, People's Publishing House, New Delhi, (1966) 1969, pp.55-141.

133 Shiv Viswanathan, *Organizing for Science : The Making of An Industrial Laboratory*, OUP, Delhi, 1985, p. 41.

134 MacLeod, " '*Kriegsgeologen* and Practical Men' Military Geology and Modern Memory, 1914-18", *British Journal of History of Science*, Vol. 28, 1995. pp. 427-50.

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 colonized' to discuss India's future industrialisation.[135] 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 organization. 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.[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".[137]

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[135] Viswanathan, *op.cit.,* p. 46. Sea particularly the pages 39 to 96 of this book for a fuller assessment of the *Industrial Commission Report*

[136] *Report of the Indian Industrial Commission , 1916-18,* (Henceforth, *IIC Report*)Calcutta Suptd. Government printing , India, 1918, pp. 83-87.

[137] *Indian Industrial Commission, Minutes* (Henceforth *IIC Minutes*), Vol. 2, p. 524.

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.[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".[139] What the (ICR) recommended was the setting up of a centralised research organization, which would provide specialization, flexibility as well as co-ordination.[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.[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 organization of chemical research in India was organised in Lahore, in 1918.[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.[143] 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

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[138] Viswanathan, *op.cit.*, p. 71.
[139] *IIC Minutes*, Vol. 2, p. 524
[140] *Ibid.*, p. 527
[141] *IIC Report*, pp. 92-93.
[142] *Proceedings of a Conference for the Consideration of the Organization of Chemical Research in India.* Held at Lahore , January 8th 1918, Government of India, Indian Munitions Board, Simla, Government Monotype Press, 1918
[143] *Ibid.*, p. (3) 1.

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.[144]

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".[145] 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.[146] 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".[147] The 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

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144 *Ibid.*, p. 2.
145 *Ibid.*
146 *Ibid.*
147 *Ibid.*
148 *Ibid*, p. 10.

thereafter came to India to organize a Department of Industries to coordinate 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 the1920s 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 attitude of geologists towards their subject. This is were we are getting our focus back on geology and discuss other geologists who explored similar possibilities. The next section would focus on them.

[149] Fermor , "Tables of production", p. 473.
[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.
[152] "Annual Dinner", *Transaction,* Vol. XV, 1920, p.44.

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 civilization. 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 civilization, 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.[153]

The MGII attempted to coordinate 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.[154] 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 and better to do our duty to ourselves, to the mineral industry for which we labour, and to the land we live in."[155]

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

[153] "Presidential Address", *Transaction,* Vol. XXIV, 1929, p.17.
[154] Pickering and R.R. Simpson, " Fighting a Colliery Fire", *Transaction,* Vol. 2, 1908.
[155] Quoted in P.K. Ghosh, *op.cit.,* pp. 58-59.

ventilation[156] and the health of the miners.[157] 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.[158]

In the GSI, too, minerals had become a major concern. In the very first *Quinqueninial 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.[159]

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 not withstanding. 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

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156 F.L.G. Simpson, "Preliminary Note on the Ventilation of Indian Mines", *Transactions*, Vol. XV, 1921.
157 W. Simmons, "Suggestions for the Improvement of Labour Conditions at Indian Coal Mines and for Labour Saving", *Transaction*. Vol. XV, 1921.
158 Henry Hayden, "Mineral Development in India", *Transaction*, Vol. Ix , 1916.
159 *Records*, Vol. XLVI, 1915, pp. 8-14 and pp. 100-107.

factors, gradually led to an appreciation of the gravity of the situation by the authorities.[160]

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.[161]

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".[162] 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.[163]

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

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[160] See P. K. Ghosh *op.cit., pp. 53-4.*

[161] G. F. Adams, E.W. Robertson and Glen George, "Report of Mining Education in England with special Reference to India", *Transaction* Vol. XI, 1917.

[162] C. H. McCale, "Presidential Address", *Transactions,* Vol. XIII, 1919, pp. 15-16.

[163] *Ibid.,* p. 16.

country.[164] He raised a simple but pointed question, "... I think it right to mention what seems to me 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?"[165] 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."[166]

The colonial geologists also took the cause of Indian industrialization 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.[167] 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?[168]

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

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[164] Simpson, "Presidential address", *Transaction*. Vol. XXIV, 1929, p. 28.
[165] *Ibid.*
[166] *Ibid.*, pp. 28-29.
[167] N. P. Gandhi, "Presidential address"; Geology Section *Proceedings of Indian Science Congress* (Henceforth *Proceedings)*, Vol. 20, 1933. P. 337.
[168] Quoted in Gandhi, *Ibid.*

commonwealth mineral the GSI prepared the list of Indian minerals.[169] 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.[170] 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.[171]

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.[172] 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 Organization of India's Minerals Industry", firmly established the cause for organising mining, marketing, industrial co-operation in minerals under the control of government.[173] He argued that minerals industry should be developed by the state because of its non-profit motive and its ability to provide industrial

[169] Fermor, "Tables of Production", *op.cit.*, p. 473.
[170] See "Annual Dinner", *Transaction*, Vol. XXIII, 1928, p. 48.
[171] *Transaction*, Vol.39, March, 1943, No. 1 PP. 45-70.
[172] Fox, "Annual Dinner", p. 15.
[173] *Transaction* , Vol. 39, March, 1943, No. 1 p. 19

security by controlling foreign trade, in which the GSI could play a more active role.[174]

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.[175]

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.[176]

In 1939, D. Farquhor 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".[177]

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

174 *Ibid.*
175 P. K. Ghosh, *op.cit.*, p. 56.
176 *Transaction*, Vol. 41, 1945,April No. 1 pp. 1-7.
177 *Transaction*, Vol. 35, part I 1939, p. 12.

geology in Europe cut if off from the eighteenth century Romanticism with which it was associated in the earlier era.[178] 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.

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.[179]

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

[178] Michael Shortland, "Darkness Visible : Underground Culture in the Golden Age of Geology", *History of Science*, Vol. XXXII, 1994.
[179] Pearson, *op.cit*, p.3.

thinned out.[180]

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 Britain as in India, and twenty five times as much of other minerals.[181]

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.[182] (emphasis mine)

In the *Quiquennial 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.[183]

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-

180 "Annual Dinner", *Transaction*, *Vol. V, 1910, pp. 61-62.*
181 *Ibid.*, p. 62.
182 *Transaction*, Vol. VII, 1914, p. 28.
183 *Records*, Vol. LVIII, 1925, p. 128.

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 regarded as part of a defense problem".[184] 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.[185]

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.

[184] Viswanathan, *op.cit.*, *p. 73.*
[185] Chatterton, *op.cit*, pp.339-340.

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 India" and that its staff should not become "an army of prospectors".[186]

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".[187]

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.[188]

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

[186] *IIC Minutes*, Vol. 2, p. 373.
[187] *Ibid.*, p. 660.
[188] *Proceedings*, Vol. 4, 1917, p. 13.

for its pursuit. The cultural value of such a science is not to be despised."[189]

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 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."[190]

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."[191] 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

189 W. A. Parks, "Cultural Aspects in Geology" (Presidential address), *Report of the British Association for the Advancement of Science*, 1925, (Henceforth *Reports)* pp. 55-74

190 Holland, (Presidential Address), Section L: Educational Science ,*Report BAAS*, 1926, pp. 246-254.

191 B. Wilson Haigh "Presidential Address", *Transaction* Vol. 42, May 1946, No. 1, p. 16.

and Paleontology.[192]

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.[193]

In the Central Provinces L.L. Fermor studied the Archoeans of Nagpur, Bhandare and Chhindwara districts for 20 years.[194] Fermor's actual project dealt with the correlation of the Archoeans of different parts of India, using marbles as confirmatory evidence.[195] 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.[196]

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.[197] Second, geologists from India, such as the Blanford brothers played an important role in challenging European theories regarding the early history of the planet.[198] 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 Gondowana system, "well before Edward Suess gave the name Gondowana Land to the pre-tertiary Southern

[192] 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.*
[193] A. M. Herson, "Geology of Rajputana", *Memoirs*, Vol. XLV.
[194] Wadia, *op. cit.*, p. 90.
[195] Fermor, "Correlation of the Ancient Schistose Formation of Peninsular India", *Memoirs*, Vol. LXI.
[196] Lt. Colonel John L. Grinlinton, "The Former Glaciation of East Lidar Valley, Kashmir", *Memoirs*, Vol. XLIX. Part 2, 1928.
[197] 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.
[198] *Ibid.*, pp. 14-17.

Continent.[199] 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."[200]

The study and discovery of India's natural world led scientists to a 'lost 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.[201]

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".[202] Extending this geographical determinism he argued that man was ultimately the "helpless child of geology".[203] 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".[204] Geologists thus still appreciated natural harmony and were ready

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[199] *Nature*, May 8, 1937, vol. 139, pp.809-810.
[200] *Ibid.*, p. 17.
[201] Guy E. Pilgrim, "The Correlation of the Siwaliks with Mammal Horizon's of Europe", *Records* , Vol. XLIII, part 4, 1913,p.1-3.
[202] Fermor, "Presidential Address", Indian Science Congress, 1933, *Current Science*, Vol. I, 1933, p.20.
[203] *Ibid.*, p. 204.
[204] *Ibid.*, p. 205.

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. [205] 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. [206]

Colonial Indian geological discourse indeed had this hybrid character. Given 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' 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". [207] 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 Orienatalists such as William Jones who rejected Linnuean 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

[205] Catherine Nash, "Geo-centric Education and anti -Imperialism : Theosophy, Geography and Citizenship in the Writing of J. H., Cousins", *Journal of Historical Geography*, Vol. 22, No. 4, 1996, pp. 399-411.
[206] *Ibid.*, p. 411.
[207] Holland, "Presidential Address; 1907" *op.cit.*, pp. 35-50 also his "Indian Geological Terminology", *Memoirs*, Vol. XLIII, 1913, part I., pp., 1-13.

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.[208]

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 Chota Nagpur coal mines 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.[209]

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.[210] For Fox, the most significant model remained the geological department of the USSR, which

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[208] Fermor, "Report on the Eleventh International Geological Congress ", Stockholm, 1910", *Records*, Vol. XLI, Part 4, 1912, p. 286.
[209] Quoted by P.K. Ghosh, *op.cit.*, p.58
[210] Fox, "Annual Address", *op.cit., p. 14.*

in unique ways played an active role in industrialisation.[211] In USSR, geologists "had to prove their practical value in a thoroughly satisfactory way".[212] 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..."[213]

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".[214]

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 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.[215] 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.[216] The nature of industrialisation was at the best 'stunted'. Large-scale production employing modern methods remained confined to

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[211] *Ibid.*, p. 15. Also his "A Resume of the Exploration for Minerals, Ores. Etc. Since the outbreak of War, and Suggestions for Increasing its Value in Industrialisation ",*Bulletin of Economic Minerals. Records*, Vol. LXXVI, No. 1, 1912, p. 21.
[212] Fox, "A Resume", p. 21.
[213] Fox, "Annual address", p. 15.
[214] Fox, "A Resume", p. 21.
[215] Bagchi, *Private Investment*, pp. 53-58
[216] *Ibid.*, p. 56.

consumer goods industries. The development of capital goods industries was extremely meager and the share of modern industry in total national income was low.[217] 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 metropolitan industrial interest 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.[218]

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. His critique of government educational policy, Indian foreign trade, metropolitan scientific hegemony therefore, does not fall within 'nationalist' or 'imperialist' thought.

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.[219]

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[217] *Ibid.*, pp. 440-443.
[218] Basudev Chatterji, *Trade , Tariffs and Empire: Lancashire and British Policy in India, 1919-1939*, OUP, Delhi, 1992, p. 61, 95-100.
[219] "Holland", *op.cit.*, p. 233.

Holland's recommendations in the Industrial Commission were never implemented. Nor were the recommendations he made at other seminars.[220] 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".[221]

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.[222] 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...." [223] 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 in different parts of the country, he felt, had unfortunately stopped.

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[220] Bagchi, *op.cit.,* p. 57.
[221] Nasir Tyabji, "The Hiatus between Chemistry and Chemical Engineering and Other Lessons from Inter-War Colonial Madras", *Journal of the Japan-Netherlands Institute* ,Vol. VI, Tokyo, 1996, p. 144.
[222] 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 saxo florist", 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.
[223] "Annual Dinner", *Transactions*, Vol. XV, 1920, pp. 45-46.

Fermor 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".[224] Clearly, both Holland and Fermor 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.[225] 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).[226] His plans to set up scientific research laboratories, anticipated the National 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 metropolis.

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[224] Former, "The Utility of Geology to Man ", *Transactions,* Vol. 1922, p. 16.
[225] Dewey, *op.cit* , p.240.
[226] MacLeod, "Scientific Advice", pp. 382-383.

PART II

NATIONALIST VISIONS

Introduction

It is now necessary to go back a few years to record another major development in the history of western science in colonial India- the entry of Indians in scientific debates and research. The first effort towards institutionalising Indian interest in western science was Mahendra Lal Sircar's Indian Association for the Cultivation of Science (IACS, 1876). The basic aim of the Institute was to encourage Indians in scientific research and to popularise the same. Within a few years of its establishment, seven sections were set up: physics, chemistry, astronomy, mathematics, systematic botany and geology. Other efforts in this direction were also made. In 1902 Satishchandra Mukherjee launched the Dawn Society to promote the idea of national education. The society's journal, *The Dawn* provided an important forum for Indian scientists to promote and popularise science. The Indian Institute of Science and the Bose Research Institute came up gradually. With the formation of the Indian Science Congress Association in 1914, Indian scientists gained a broad platform on which exchange ideas.

Such developments are commonly referred to as 'nationalist' science. The relationship of scientists and science enthusiasts' associations with the national movement has been well documented.[1] My interest here is to study how the developments in this phase influenced the story of science in colonial India. I locate the Indian endeavour in science at two main levels. First, was the question of cultural and historical intervention to secure Indian roots within a European discipline. Second, was the political and economic question of applying scientific knowledge to national prosperity. Three chapters are concerned with the first process. In this context, the first chapter studies the pioneering IACS and the man

[1] I am referring here to the writings of Dhruv Raina, S. Irfan Habib, Deepak Kumar, Ashis Nandy and Shiv Viswanathan, discussed in this thesis.

responsible for its existence.

Before I discuss the attempts to understand and 'indigenise' western science, I state my understanding of 'western' science and my disagreements with the Needhamian notion of 'modern' science which claims it is a universal, ecumenical discipline formed by the various streams of 'ethno-sciences' hailing from China, Europe, India and the Islamic world. According to me, such a concept views the transmission of knowledge from one spatial and temporal location to another in somewhat simplistic terms.[2] It is important to view the question of 'transmission' of scientific knowledge in a different manner.

In the twelfth century, the transmission of scientific knowledge from the Islamic world and ancient Greece became crucial to Europe. It was a century when the Florentine economy was expanding, the crusades were in full flow, and Europe's contacts with the East were at an all time high. The Arabs in Spain were fascinating the western world with their scientific and philosophical discoveries. This was also the century in which Europe was trying to absorb these influences and to evolve a new culture. As Umberto Eco suggests, Europe was trying to create for itself a culture that would reflect a political and economic plurality, dominated not merely by the church, but a new sense of nature, of concrete reality and of human individuality.[3] This period was also marked by Europe's renewal of interest in 'its' past-Greece.

Greek texts had been brought into Persia due to the persecutions of the Orthodox Byzantine Church from the fourth and fifth centuries. Schools were set up for teaching studying, translating and commenting upon Hellenistic knowledge. This trend continued into the seventh and early eighth centuries. From the eighth to the tenth centuries, a record number of translations occurred and this body of literature was gradually drawn into Muslim culture and society

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[2] See of J. Needham, *The Grand Titration*, London, 1969.
[3] Umberto Eco. "In Praise of St. Thomas" in his *Travels in Hyperreality*, Picador, 1987, p. 260.

in the Arab world.[4] These translations, underwent a process of nativisation when they were reinterpreted in Islamic terms.[5] The Arab-Islamic world divided Greek science according to its own needs into the "metaphysical and rational encyclopaedic schools". What we understand as the Arab society, was itself a complex world whose science was already accepting contributions from Persia and India. Thus, a number of critical Islamic elements were moulded into the already complex nature of Greek, Indian and Persian astronomical learning and practise.[6] Changes, such as a compromise between Aristotle's concentric cosmology and Ptolemy's theory of planetary motion based on epicycles, the use of instrumentation and the drawing of star maps were introduced. The result was that the Greek corpus was transformed; 250 years of possession and cultural incorporation had intervened. It was no longer the same 'Greek' knowledge.[7]

It was this 'Arabized and Islamized' Greek knowledge that entered Europe through Arab literature from the twelfth century. In Europe this was also a period of transformation from the 'oral' tradition to 'written' text and the 'vernacular' revolution.[8] It was also a period of major social change. New technologies based on waterpower and urbanisation were now taking place. Artisans and craftsmen gained freedom and productivity and were liberated from local feudal lords.[9] Few in Europe knew Greek except for the Arabs. However, thanks to the Crusades, the Christian attitude towards Islam was clearly hostile, creating problems as regards the dependence on Arabic-Islamic sources for Greek learning. A compromise was reached. Technical knowledge in Arabic was not seen as linked with Muslim religion and culture. This resulted in the severing of Arabic learning from Islamic culture in Europe[10] and was followed by the

[4] Scott L. Montgomery, "Naming the Heavens: A Brief History of Earthly Projection', Part II: Nativising Arab Science", *Science As Culture*, Vol. 6, Part I, No. 26, pp. 73-75.
[5] Seyyed Hussein Nasr, *Science and Civilization in Islam*, Harvard University Press Cambridge, 1987, pp. 29-33.
[6] Montgomery, *op. cit.*, p. 85.
[7] *Ibid., p.87.*
[8] *Ibid., p.94.*
[9] *Ibid.*, pp. 93-94.
[10] *Ibid.*, p. 107.

growth of the idea of a 'lost' knowledge about Greece. To be 'found', this knowledge had to be stripped of its history and its contents that made it the inalienable property of another people.[11] From the thirteenth century Greek sources were used instead of Arabic ones. In the fourteenth century, translation from Arabic had practically stopped when the Mongols overran Mesopotemia and Persia. Greek, by then, was ensconced in Europe as the language of the philosophy of science.[12] From the late thirteenth century, universities in Europe collected Greek texts. Research on manuscripts in the West was matched by a continuing effort to acquire copies of Greek authors from the wreck of the Byzantine world. Greek culture had by now become the 'heritage' of Europe.[13]

The other process was the christianisation of Greek thought. The role of Thomas Aquinas was crucial in 'christianising Aristotle'.[14] He matched the Christian theological order with the materialism of Aristotle seeking to know why man knows things, why his body is made in a certain way, why he has to examine facts and opinions to make or decision, and resolve contradictions without concealing them.[15]

So, the early sixteenth century Europe had established had 'found' its Greece and the idea of a 'reawakening' of classical antiquity. It gave the very idea of 'Europe' (Europe- a sacred portion of Greece) its grounding and rationale. In absorbing and nativizing the knowledge of the East, Europe chose to shed this knowledge of certain elements. It chose to gradually define this knowledge as its own by manufacturing a genealogy of heroic descent from Greece. This meant the stripping away of all things Islamic. Latin culture looked gradually inward even as it drew sustenance from outside.[16] The new knowledge of Europe was

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[11] *Ibid.*
[12] *Ibid.*, pp. 109-110.
[13] Myron P. Gilmore, *The World of Humanism , 1453-1517*, Harpers and Brothers Publisher, New York , 1952, pp. 182-183.
[14] See Eco. *op. cit.*,
[15] *Ibid.*, pp. 265-266.
[16] Montgomery, *op. cit.* p. 116.

thus its own, not Islamic, not even Grecian. In choosing 'Greek' culture, what it really chose was a series of textual communities, long nativized by the Islamic world. The 'purity' of Greek civilisation was lost to the past.[17] Europe created a 'new Greece for itself.[18]

From now on Europe's intellectual history had a checkered career with many discontinuities, shifts and reinterpretations. It was also endowed with a certain amount of self-consciousness and inwardness. It was on the foundation of thus 'Europeanised' Greek learning that the Copernican Revolution took place whereby heliocentric notions were gradually shed to shape a new world view. It was a complex process, which started with Copernicus' attempt to solve the mystery of the calendar year.[19] Subsequently, Francis Bacon attempted to develop a new methodology of logic. It was based on a rigorous process through which the human mind was tied down to a strict inductive methodology of collecting materials and arranging and deriving new knowledge which would ensure the unique truth and the realisation of the ideas of the Divine Mind. In doing so he propagated a new way of looking at the nature of this 'conquest' by human beings.[20] Bacon was probably the earliest prophet of 'modern science'. The evolution of this science is a complex process. It marked a complete break from traditional scientific knowledge for it not only eclipsed the religious and

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[17] *Ibid.*.

[18] The process of identifying Greek thought as a solely European heritage and Greek science as the only one of its kind was so complete, that even critical philosophers of science like Kuhn and Ben-David seem to accept this without hesitation. Kuhn, while arguing that the bulk of the scientific revolution in Europe was a product of the past four centuries pointed out that Europe, as the only "descent from Hellenic Greece have possessed more than the mere rudimentary science". See his *Structure of Scientific Revolution,* New American Library, 1986 (1962), New York, p.137. Joseph Ben- David in a slightly different mode argued that only Greece could be the "legitimate ancestor" of modern European science, as only it had a logical structure". So a 'scientific' Europe could only have a equally 'scientific' Greece as its ancestor. The Arab legacy was easily forgotten. See Ben David's, *The Scientists' Role in Society : A Comparative Study* The University of Chicago Press, Chicago and London, 1984 (1971), p. 33.

[19] Kuhn, *The Copernican Revolution: Planetary Astronomy in the Development of Western Thought*, Modern Library Paper books, Random House, New York, (1957), 1959.

[20] Jatinder K. Bajaj, "Francis Bacon, the First Philosopher of Modern Science : A non-western View", in Ashis Nandy (ed.), *Science Hegemony and Violence: A Requiem for Modernity*, OUP, Delhi, 1990, (1988), pp. 24-67.

traditional philosophical understanding of nature, but it also relegated 'traditional' science to the margin of intellectual activity and to the category of superstition. Modern science, therefore, is not simply the continuation of Islamic, Greek or Latin sciences. A major change of worldview or paradigms separates modern science from its medieval counterparts.[21]

The rejection of the medieval cosmology was a more general process in European intellectual history, which is particularly engendered in Renaissance humanism. A very significant aspect of it was the negation of the 'other worldness' of man in the medieval Christian theology as a half-angel, half-man. Man became completely terrestrial, at home in a newly discovered planet. Man was defined more in terms of his individuality, reason and the use of senses. Henceforth, reason, which severed philosophy from revelation, came to be the sole criterion of verification of the knowledge along with man's sensory perceptions. Faith in God was still important, but it could not prevent the gradual desacrilization of knowledge that characterized European intellectual history from the Renaissance onwards, particularly the knowledge seeking to understand nature.[22] The eighteenth and the nineteenth centuries made further studies in the conquest of nature by defining new fields of visibility vis-a-vis the same. It developed a new way of seeing nature, particularly in disciplines like botany and biology in parts, "a series of systematically negative condition" and through a new medium, the microscope. By limiting and filtering the visible, nature could be better transcribed into a language and helped in the development of scientific taxonomy and classification. Nature was engraved into the material of language, transposed and re- constituted.[23]

The Post-Enlightenment theories such as positivism and utilitarianism, increasingly gave rise to a historically progressive philosophy of life from the

[21] Nasr, *Religion and the Order of Nature*, OUP, New York, Oxford, 1996, pp. 126-127.
[22] *Ibid.* pp. 169-176.
[23] Michel Faucoult , *The Order of Things : An Archaeology of the Human Sciences*, Vintage Books, New York, 1993, pp. 132-138.

early nineteenth century. Charles Darwin removed the question of 'first cause' from evolution and turned it into a struggle between various species for existence.[24] Auguste Comte's positivism was also part of the nineteenth century philosophical reaction against the attempts of metaphysicians to discover the ultimate nature of reality. Comte argued that scientific investigation could lead to universally valid laws that would allow man to control not only the physical universe but societies as well.[25]

Reviewed above was the particular orientation science took in Europe. European science was located in its temporal and spatial dimensions. The trajectories of Islamic science, were quite different. As Nasr has shown, Islamic science has to be seen as a creative refusal, an affirmation of a different world, a refusal to profane nature. He asserts that in the Islamic world, India and East Asia, nature was never shorn of a sacramental and spiritual character. Even the intellectual dimensions of these traditions were not so 'enfeebled', as to enable a purely secular science of nature to develop, outside the matrix of traditional intellectual orthodoxy. Even if the cosmic vision of Copernicus and Kepler or the Arabs were similar, the paths they took to truth were divergent.[26] Sivin has argued that Chinese science has to be studied within the context of Chinese society. His contention is that while the modern-style mathematisation of astronomy was carried out by the seventeenth and eighteenth centuries Chinese astronomers, like its western counterpart, it did not lead to a scientific revolution.[27] Nasr provides an important clue to the question of why modern science developed in Europe. The first factor was the weakening of the Sapiental dimension in Europe which aided the rise of rationalism. The eclipse and marginalisation of Christian philosophy during the late medieval period and the all-important rise of

[24] Kuhn, *Structure of Scientific Revolution*, pp. 140-142
[25] Geraldine Hancock Forbes, *Positivism in Bengal; A case Study in the transmission and Assimilation of an Ideology*, Miners Associates (Publication) Private Limited, Calcutta, 1975, pp. 6-7.
[26] Nasr, *Man and Nature*, Unwin Paper books, London, 1976.
[27] Nathan Sivin, " Why the Scientific Revolution Did not Take Place in China - a Didn't it ?", in *Chinese Science*, no. 5, 1982, pp. 45-66.

humanism in Renaissance marked the incubation and formation of modern science.[28]

It was such an European science that came to India largely from the eighteenth century onwards. Here we come back to our story. It was necessary to locate European science within its cultural context because the knowledge that came to India was accompanied by a cultural redefinition, by an essentialism which proclaimed its own universality, and validity to be independent of culture. It was a part of the discourse of power within an imperialist context. Rationality assumed a very definite form in the post-Enlightenment view of the world. Natural sciences became the paradigm of all rational knowledge. This science was characterised by the idea of man's control over nature, a progressive and ceaseless process of appropriation of nature to serve human 'interest'. As Partha Chatterjee argues, rationality was seen as incorporating a certain way of looking at the properties of nature, of ordering the knowledge of those properties in a certain consistent and coherent way and of using this knowledge of adaptive advantage vis-a-vis nature.[29] What accompanied this development was the 'essentialism' of the rationalist ethic. This particular form of rationality, located in the historical specification of Europe, was seen as a characteristic of' 'scientifically' oriented cultures. Other cultures were viewed as 'unscientific' societies which in the cultural values of post-enlightenment thought were seen as 'backward' and 'uncivilised'. The universalism of such scientific knowledge reflected Europe's self-consciousness, inwardness, and an obsession with its 'origins' located in Greece and a continuous flow of enlightenment which transcended all boundaries. It also reflected in another sense the hegemonistic homogenising, imperialist and elitist tendencies of this knowledge.[30]

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[28] Nasr, *Religion and the Order of Nature*, pp. 130-132.

[29] Partha Chatterjee, *Nationalist Thought and the Colonial World ; A Derivative Discourse?*, OUP, Delhi, 1986 p. 16.

[30] In much the same way, the fascist ideology of 'Hindutva' has sought to redefine Hinduism in contemporary India.

A few years ago, Jerome K. Ravetz argued that the main problem of nineteenth century science was 'epistemological' (as opposed to the 'social' which developed after World War II). He meant that in the nineteenth century contest for cultural authority, naturalistically inclined scientists had to show how and why their knowledge was the most reliable and powerful.[31]

So the story discussed here witnessed both hegemonization by western science as well as contestation between various epistemologies. This process in colonial India is even more interesting because of its association with nationalism. Nationalist thought itself, in nineteenth century India, was a contested domain. As Partha Chatterjee comments, the problem of nationalism thought becomes a "particular manifestation of the bourgeois-rationalist conception of knowledge, established in the post-Enlightenment period of European intellectual history, as the moral and epistemic foundation of a supposedly universal framework of thought which perpetuates in a colonial domination"[32] Ashis Nandy has shown how the very act of Indian nationalism was a process of 'colonisation of the mind'. It internalised various Christian and Victorian values of religion, masculinity and gender, which in turn became the mainstay of such nationalistic assertions.[33] At the same time these scholars have argued for dissent and cultural creativity within this process.[34] Consequently, the

[31] See his *Scientific knowledge and Its Social Problems*, New Brunswick, N. J. Transactions Publishers, 1996 (1975), p. 50.
[32] Chatterjee, *op. cit.* ,p. 11.
[33] Nandy, *The Intimate Enemy; Loss and Recovery of Self Under Colonialism*, OUP New Delhi, 1983.
[34] For Nandy's study of creativity among Indian scientists, such as J. C. Bose and Ramanujan, see A. Nandy, *Alternative Sciences : Creativity and Authenticity in Two Indian Scientists*, Allied, New Delhi, 1980. Chatterjee, acknowledges the creative aspects of nationalist discourse much more in his later book. There he argues that nationalism created its own domains of sovereignty within colonial society by creating a divide between the material and the spiritual spheres. The colonial state was only permitted in to the material sphere while the spiritual domain remained nationalism's sovereign domain. It is from here that Chatterjee believes that most creative and powerful nationalist imaginations drew their sustenance . Nationalism thus cannot be merely seen as a *political* movement as we have hitherto assumed so, 'too literally and too much seriously'. See his, *The Nation and its Fragments; Colonial and Post-Colonial Histories*, OUP,Delhi,1994,pp.5-7.

study of Indian nationalism is thoroughly absorbing. To understand the discourse of 'nationalist science' it is necessary to grasp the broad strains of Indian nationalist thought.

Nationalism at a Glance

The world of the Indian intelligentsia in the early nineteenth century was expanding through contact with an alien culture. This both delighted and troubled them in turns. The western humanities and sciences delighted the learned, educated class. They were fascinated by Shakespeare, French Revolution, the American War of Independence, Charles Darwin and Auguste Comte. Thus new learning opened up new means of livelihood for the urban elite.

Trouble arose with the realisation that there was a great gulf that existed between their civilization and the West. Moreover having to face racial discrimination and Christian missionary criticism there arose a self-assertion, a search for cultural and civilizational inheritance as well as self-criticism. The result was a growth of nationalist ideology, through which Indians sought to 'educate', unite and assert themselves vis-a-vis the West. However, the nationalistic reaction to western civilization often look diverse, unprecedented, unpredictable and even eccentric ways.

Ram Mohan Roy responded to these changing perspectives by introducing into the culture of India's expanding urban middle class the ideas of organised religion, a sacred text, monotheism and a patriarchal Godhead.[35] Michael Madhusudan Dutt sought to redefine popular mythology to contain within an Indian worldview Victorian notions of men and women, adult and infants, and to put forward the more 'valued' aspects of India's culture to the West.[36] Bankim Chandra Chattopadhyay (1838-94), also directly addressed the question central to Indian cultural nationalism- whether European civilisation was superior. In an

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[35] Nandy, *Intimate Enemy*, p. 21.
[36] *Ibid.*, pp.22-24.

argument which fell into the Orientalist classifications, Bankim argued that Europe was equipped with a superior material culture as opposed to Indian religiosity and spirituality. The very passivity of Indian culture was responsible for the domination under foreign rule for seven hundred years. He argued in favour of a reformed Hindu religion cleansed of the "rubbish of the ages," a complete system of culture which could counter western invasion. Thus, he felt, would be a far more ethical ideal for modern India, than materialistic western civilization.[37]

In the nationalist ideas of Swami Dayanand Saraswati (1824-83) and Swami Vivakananda (1863-1902), the notion of a Hindu culture as a perfect alternative to Christian material culture developed sharper edges. During this process they sought to christianize Hinduism, identifying the west with power and hegemony, in turn identified with a superior civilization.[38]

The epistemological principles on which Indian nationalism was based and the ethical principles to which it appealed were all drawn from western notions of secularism, religion, adulthood, rationality and patriotism. The ideas of M. K. Gandhi and to some extent Iswar Chandra Vidyasagar were rooted in a different culture of logic and principles. Vidyasagar's search for a critical awareness of Hinduism and colonialism was not drawn from a feeling of cultural inferiority but from a perceived contradiction within Hinduism itself. His nationalism was not defined by western rationality, utilitarianism, and social Darwinism and he refused to 'semitise' Hinduism. He sought to maintain Hinduism as an open anarchic federation of sub-cultures and textual authority open to new interpretation and political dissent.[39]

Neither was Gandhian nationalism based on western notions of progress, utilitarianism and materialism. He did not attempt to posit Hinduism as a superior

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[37] Chatterjee, *Nationalist Thought*, pp. 54-84.
[38] Nandy, *Intimate Enemy*, p. i.
[39] *Ibid.*, pp. 27-29.

version of spirituality. Instead, he developed his own spiritual philosophy and wedded that to political and social action. Although Gandhi's critique of modern civilization may be located within romantic traditions of contemporary Europe, the uniqueness of his thought lay in its practical application, through a political movement against a colonial regime. At the political and practical levels, he redefined ahimsa and satyagraha.[40]

Nationalism subsumed various issues such as religious, materialism, progress and political strategy. I hope to narrow my study down to focus on western science. Nationalism, was the product of an interaction with foreign knowledge systems. Science, as the great denominator of nineteenth century European knowledge posed as the most important component of that interaction. The transfer of knowledge to India sometimes involved a passive process of diffusion through scientific knowledge, while the ideology of science was actively redefined in the milieu of the recipient culture.

One of the reactions to this development was the initiation of a culture of self-critique and to introduce scientific knowledge to stimulate the 'obsolete' traditional thought. Ram Mohan's fascination for Lord Bacon made him write to Lord Amherst, urging him to introduce Bacon's method of new learning as opposed to Sanskritic studies in India. Sanskrit studies, he was afraid, would only lead the minds of Indian youth to grammatical niceties and metaphysical distinction. What was needed was the 'enlightened' knowledge of natural philosophy and science to develop truly rational Indian mind.[41] Gosto Behari Mallick, the Secretary of the Burra Bazar Literary Club, saw western scientific education as the only way for India to be saved from the "depths of ignorance and superstition."[42] Even a Maulavi Ubaidullah commented that European critical

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[40] Chatterjee, *Nationalist Thought*, pp. 85-130; also see Nandy, *Intimate Enemy*, pp. 48-57.

[41] P. C. Ray, *Life and Experience of a Bengali Chemist*, Chuckerbutty, Chatterjee and Co. Ltd., Calcutta, pp. 140-141.

[42] Gyan Prakash, "Science Between the Lines", in Shahid Amin and Dipesh Chakarborty (eds.) *Subaltern Studies Writing on South Asian History and Society*, Vol. IX, OUP, Delhi, 1996, p. 67.

rational, reformist attitudes could help Muslims in their "rapid progress" towards an "actual civilization."[43]

In the nineteenth century Bengal, Positivism appeared as a new religion of humanity and Comte and Congreve the new gurus. Krishna Kamal Bhattacharya, the son of a Brahmin priest, had lost faith in Hinduism as it was unable to counter the challenge of science. India, he felt, needed a higher morality which only the new religion of positivism could provide. Guru Das Chattarjee, another early positivist felt the urge for radical social reform of Hindu society through positivism. Dwarkarnath Mitra, a brilliant advocate and a prominent individual in nineteenth century Bengali society read Comte in French. He accepted positivism and saw in it the right path towards moral and material progress of all human beings. Like the others Jogendra Chandra Ghosh believed that India could be regenerated along positivist lines. He believed that in such a process, he would play the role of a philosopher.[44]

With Jogendra a significant shift is noticeable towards the cultural redefinition of positivism. Realising that a regeneration of Indian society could not possibly ignore Hinduism, Jogendra sought the roots of rationalism, materialism and atheism within Hinduism. He also developed a theory of social change in India from Vedic times to the present. He argued that Hindu thought had elements of positivism embedded within it.[45] This redefinition of ideas reached a more mature stage under Bhudev and Satish who tried to locate the fundamentals of rationalist thought in Hinduism.[46] N. K. Ramaswami Aiya blended positivism, classical Hindu texts and modern science to authenticate a monotheistic Hinduism.[47] Master Ramchandra tried to recover Indian algebra so

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[43] Deepek Kumar, 'The 'Culture' of Science and Colonial Culture, India 1820-1920", *British Journal of History of Science*, Vol. 29, 1996, p. 197.
[44] Forbes, *op. cit.*, pp. 50-96.
[45] *Ibid.*, pp. 85-96.
[46] *Ibid.*, pp. 125-146.
[47] Prakash, *op. cit.*, p. 77.

as to resuscitate "the native disposition".[48] In fact, even earlier the acceptance of an alien culture had involved negotiation, invention and redefinition.

Bal Gangadhar Jambhekar was a pioneer in science activism. He was the first Indian to teach mathematics at Elphinstone College, and the first to start a journal to popularise science (*Bombay Darpan*, 1831). He also established the Native Education Society. His perception of the distinction between the 'East' and the 'West' ran on conventional lines. To him the 'west' was superior because it had developed its material interests through science while 'Eastern' philosophies had concentrated on metaphysical questions.[49]

However, as a man of action he was more concerned with the practical choices facing the 'East'. In the field of medicine, his ideas were unique. He believed that hakims and vaidyas should be made aware of modern anatomical knowledge as they were far better equipped to grasp these than ordinary people. What Jambhekar was essentially arguing for was a process of slow change, whereby the practitioners of traditional knowledge systems could be made aware of new knowledge. This, he believed, would eliminate the risks of radical transformation.[50]

The Dawn Society in the heyday of *Swadeshi* in the first few decades of the twentieth century was involved in similar experiments. It attempted to combine the roles the traditional and modern technicians to make them the primary agents of social transformation. Indian artisans were seen as central to the industrial transformation of India. But, it was felt they required better tools and implements, pecuniary support, and a knowledge of market trends and fashions. This would necessitate a training in modern science, with the state

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[48] Dhruv Raina and S. Irfan Habib, "Ramchandra's treatise Through 'The Haze of the Golden Sunset' : An Aborted Pedagogy", *Social Studies of Science*, vol. 20, 1990. pp. 455-72.
[49] Kumar, "Unequal Contenders, Uneven Ground : Medical Encounters in British India, 1870-1920", in A. Cunningham and B. Andrews (eds.), *Western Medicine as Contested Knowledge*, Manchester, 1997, pp. 170-171.
[50] *Ibid., p.171.*

providing the infrastructure through technical schools and financial support.[51]

In sharp contrast to these attempts to negotiate and absorb foreign knowledge, some instances of total rejection of the same by traditional practitioners also took place. This was noticeable particularly in the field of medicine. Ajmal Khan, a Yunani expert, and P. S. Varier reacted to the onslaught of new discoveries by synthesising traditional medicines and as organising its commercial distribution.[52]

In this very brief sketch some broad trends are noticeable in the nineteenth century Indian involvement with science. One identified the East as essentially spiritual and passive and the West as a material and superior civilization. The other was the attempt to locate modern western thought within Indian tradition in order to establish the legitimacy of the latter. A third was a slow and cautious fusion between traditional art and modern western thought and the rejuvenation of native society. The fourth was to reorganise traditional practice to counter the assault of an alien and hegemonic colonial system.

Science stirred the imagination of almost every nineteenth century Indian intellectual, even those whose primary concern was not science. This was natural because science saw itself as the apex of nineteenth century European thought and was the most aggressive, well-organised body of thought. This widened the entire spectrum of nineteenth Indian discourse on science. This has been well documented. The earliest writings on science were generally of two types. One involved a general sketch of 'scientific thought in nineteenth century India and its provinces, discussing the broad trends within contemporary scientific thought.[53] The second included biographies of important personalities who

[51] Dhruv Raina and S. Irfan Habib, "The Unfolding of an Engagement: *'The dawn'* on Science, Technical Education and Industrialisation : India, 1896-1912", in *Studies in History*, vol. 9, No. 1, 1993, pp. 87-117.

[52] Kumar, 'Unequal Contenders", *op. cit.*, pp. 176-179.

[53] A typical example of books in such a genre is B. Bhattacharya's *Banga Sahitye Vijnan* (Bengali), Calcutta, 1950; Nemai Sadan Bose, *The Indian Awakening and Bengal*, Calcutta 1969; Anil Chandra Gosh, *Vigyane Bangali* (Bengali), Calcutta.

figured as heroes of the nationalist movement.[54] They generally followed Whiggish- nationalist patterns of history writing. They accepted science and nationalism as progressive and enlightening and the story of the nineteenth and early twentieth centuries was one of a gradual, progressive articulation of these ideas. Such a stand precluded the possibilities of a more critical understanding of the contradictions, predicaments and crises such a process entailed.

The contributions to this debate are various. Ashis Nandy, in his analysis of the careers of Jagadish Chandra Bose and Ramanujan, tried to overcome this limitation. His was a sophisticated understanding of the psychological tensions and disturbances that these individuals, who accepted Western science while wanting to remain 'Indian', had to undergo.[55] A more recent trend has been generally to locate the redefinition of western scientific thought within the cultural matrix of Indian nationalism. Deepak Kumar shows how science formed the point of contest and assertion of nationalism against the colonial regime.[56] In the process, he argues, science itself was redefined and re located. Further, Dhruv Raina and Irfan Habib in a series of articles stressed the cultural transformation that science was undergoing in India in this period.[57] Through an analysis of individuals such as, Ramchandra and P. C. Ray and associations such as The Dawn , they have tried to show how Orientalist project was challenged, how the 'cultural redefinition' of science took place and how the changing images of science occurred. In this context, Gyan Prakash has argued for the 'alienation',

[54] Biographies like S. N. Sen, *Dr. Mahendralal Sircar*, (Bengali), IACS, Calcutta 1, 1986. Paper in Santimoy Chatterjee and Amitabha Sen eds. *Acharya Prafulla Chandra Ray : Some Aspects of His Life and Work*, Calcutta, India Science News Association ; J. C. Bagal, *Pramatha Nath Bose*, Calcutta, 1955; Patrick Geddes, *The Life and Work of Sir. J. C. Bose*, London, 1920.
[55] Nandy, *Alternatives Science.*
[56] Kumar, *Science and the Raj; 1857-1905*, OUP., Delhi, 1997 (1998).
[57] I have already referred to a few papers jointly written by them. Some important ones, include "Bhadralok Perception of Science, Technology and Cultural Nationalism", *IESHR*, XXXII (I), pp. 95-117; "Copernicus, Colombus, and Colonialism and the Role of Science in Nineteenth Century India", *Social Scientist*, 17 (3-4), pp. 51-66; Also see Dhruv Raina, "Evolving Perspectives on Science and History : A Chronicle of Modern India's Scientific Enchantment and Disenchantment", *Social Epistemology*, II (I) , pp 3-24.

'displacement' and 'cultural transformation' of this dominant discourse in colonial India.[58] Prakash focuses on questions of modernity and rationality with very little light on the actual shifts within science.

To my mind the focus solely on the question of 'cultural transformation' is a self-defeating exercise. Knowledge systems of one particular cultural and social matrix are bound to undergo transformations through a range of creative interventions. Such was the case with western concepts of nationalism in colonial India. Moreover, it is important to remember, as shown above, the cultural history of Western science in colonial India had begun under the European scientists.

A more important question is the nature and limits of that redefinition. What was the framework within which this transformation was taking place? Nineteenth century science was an Euro-centric and centripetal discipline. A neglect of this fact tends to glorify the levels of transformation. It also tends to show too clearly breaks within scientific thought of the Orientalist and the nationalist period. Raina and Habib, for example, tend to associate the science practised by Europeans in India completely with the colonial state and 'nationalist science' as clearly opposed to the same. It is one of my purposes to investigate more deeply the so-called binary opposition of the scientific practices of these two eras. An analysis of the complexities of the science during the nationalist era will provide new insights into this problem. To this end it is important to ask some basic questions ignored by existing historiography. Did the 'cultural transformation' and 'displacement' in nationalist thought give rise to a new science and a different way of looking at nature and the Universe? Did such developments take place in support of or in opposition to the dominant ideas of Western science? In other words, did the intellectual exercise, known as 'nationalist science' give rise to different attitudes towards nature and the Universe in contrast to western science, questioning the Euro-centric notions of

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[58] Prakash, *op. cit.*

power over and control of nature and society. And what were the frameworks of thought from and within which their ideas developed and were located?

For the examination of such questions I will examine the careers of various individuals and the institutes to which they were attached.

CHAPTER - 4

Setting the Agenda: Mahendra Lal Sircar and his Institute

I now examine the Indian Association for the Cultivation of Science (IACS), founded by M.L. Sircar and which was important for various reasons. For one, it attempted to develop an institutional articulation of the relationship between nationalism and scientific research in colonial India for the very first time. Second, the IACS stressed the importance of fundamental research in science by Indians. It encouraged Indians to explore the inner logic of science, question and develop their own hypotheses and arguments. Now Indians were presented with an opportunity to formulate new concepts of nature and the universe within the theoretical premises of experimental science.

Born in 1833, Mahendralal Sircar lost his parents at an early age and was brought up by his maternal uncle, an affluent lawyer in Calcutta. He studied in Hare School and matriculated with a junior scholarship in 1849. Sircar then joined Hindu College where he excelled in mathematics. Refusing to go in for a liberal English education, he joined Medical College in 1855 at a time when this was the only place for the study of systematic, experimental science courses. In his six years' apprenticeship, he became a trained scientist, won many prizes and was awarded a L. M. S. in 1860 and finally a M. D. in 1863 (first in the order of merit). He was the second Indian to gets this degree after Chandra Kumar De. He thereafter set up private practice and soon acquired the reputation of being one of the foremost medical practitioners of Calcutta. When a branch of the British Medical Association was set up in Calcutta under the aegis of the veteran SCG Chuckerbutty, Sircar became a member and later, its vice-president.[1]

Sircar broached the project of a national science association to the public in 1869 in his famous article "On the Desirability of a National Institution for the

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[1] *A Century*, Indian Association for the Cultivation of Science, 1976, p. 4.

Cultivation of Science by the Natives of India", in the *Calcutta Journal of Medicine* (which was started by him the same year). This was followed by pamphlets, letters to the Hindu Patriot and public addresses. He published a prospectus in the Hindu Patriot on 3rd January, 1870 and invited all "well-wishers of the progress of India' to contribute for the furtherance of the project. The first subscription account was opened on January 24th 1870 with a contribution of Rs. 1000/- from babu Joykissen Mookerjee of Uttarpara and Rs. 2000/- from Raja Kamal Krishna Bhaduri, Digambar Mitra, Babu Joykissen Singh, Iswar Chandra Vidyasagar, Maharaja Jotindra Mohan Tagore, Dwarka Nath Mitter, Girish Chunder Singh, Romesh Chunder Mitter and Anukul Chandra Mukherjee followed suite.[2]

Sircar was joined in his mission by a missionary called Reverend Father E. Lafont; a man with a keen interest in science, engaged in building a spectra-telescope observatory at St. Xaviers College, Calcutta. The new Lieutenant Governor of Bengal, Richard Temple, expressed his appreciation of and support to Dr. Sircar's proposed scheme. The first meeting of subscribers was held on 4th April 1875 at Senate House of the Calcutta University.[3]

The Association was formally established at the third meeting of the subscribers to the projected Science Association held on 15th January 1876 at the same venue. In a minute dated 21st February 1876, the Lieutenant Governor offered a building at 210 Bow Bazaar Street to the Association free of all charges. In this new premises, the Association was formally inaugurated on 29th July, 1876 Lafont and Sircar were asked to lecture on Physics and Kanai Lal De on chemistry.[4]

Sircar wanted his institute to perform two functions; one was cultivation of and research in science by Indians while the other was the popularisation of science amongst the general populace. He articulated his goals clearly in his first article.

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[2] *Ibid.*, pp. 4-5.
[3] *Ibid.*, pp. 5-10.
[4] *Ibid.*, pp. 10-12.

> We want an Institution which will combine the character, the scope and objects of the Royal Institution of London and of British Association for the Advancement of Science. We want an Institution which shall be for the instruction of the masses, where lecture on scientific subjects will be systematically delivered and not only illustrative experiments performed by the lectures, but the audience should be invited and taught to perform themselves.[5]

The Royal Institution, founded in 1799, was responsible for facilitating the general introduction of useful mechanical invention and improvement and for teaching, using philosophical lectures and experiments, the application of science for the common purposes of life. The British Association was created in 1831 to offer a forum for scientific debates and discussions on current investigations and to disseminate science among the people.

In scope and character, therefore, Sircar's institute was to perform a different role from that other pioneering institute of another era in India - The Asiatic Society- which was created to observe and understand Oriental landscape and culture. Sircar agreed that the Asiatic Society need not perform the role of spreading a scientific temper among Indians. It should continue to research on Indian nature. Sircar stressed this difference when he commented that the Asiatic Society, "does not present to humble learners any facilities for the pursuit of scientific studies". He added that, " Nor, is it necessary or desirable that it should. It is well that with its higher pretensions it should engage itself in new fields of research".[6] This difference was also part of his 'nationalist' agenda, to build a culture of science in India through its practise and popularisation. It is now time to examine that agenda more closely.

For Sircar, the practice of western science was analogous to nationalism. The one could not exist without the other. In many instances Sircar stressed that political nationalism had no meaning if it did not have science as its guiding spirit. In his worldview science was, as Arnold Thackeray puts it the, "intellectual

[5] "On the Desirability of National Institution for the Cultivation of the Science by the Natives of India", in *Indian Association for the Cultivation of Science*, by M. L. Sircar, 1877, Calcutta p. 8.
[6] *Ibid.*

ratifier of a new world order".[7] It was a metaphor for liberty and enlightenment from the preceding 'dark' ages, the catalyst for new cultural and political self-expression. As Sircar was fond of saying, "The best way, in my humble opinion, to do this (achieve nationhood) is not by platform blustering and newspaper invectives, but by substantial achievement in the field of intellect".[8]

In a brilliant passage that Sircar quoted from an established European Journal, he spoke of the virtues of blending scientific culture with that of a truly national life.

> For that interpretation of national life, past and present, without which the citizen cannot rightly regulate his conduct, the indispensable key is - Science. Alike for the most perfect production and highest enjoyment of art in all its form, the needful preparation is still - Science. And for purposes of discipline- intellectual, moral, religious- the most efficient study is - Science.... Necessary and eternal as are its truths, all science concerns all mankind for all times.[9]

Sircar felt that the scientific spirit was a clear the indicator of national progress and status. He found the two compatible because to him science was a *moral* force. Western science represented enlightenment, the path towards correct judgement, the ability to make the right choices and thus, nationhood. This moral aspect of science holds the key to Sircar's thought. It also explains Sircar's emphasis on the need for Indians to 'cultivate' modern science on their own. This is the first of the two pillars of Sircar's nationalism.

Science, Morality and 'Cultivation'

Sircar's understanding of science, as a moral force can be located within Baconian and Comtean ideas of scientific morality. Bacon's new scientific methods sought to provide a true moral guiding force by leading the human mind

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[7] "Natural Knowledge in Cultural Context : The Manchester Model", *American Historical Review*, Vol. 79, No.3, 1994, p.

[8] *Annual Report of the IACS,* (henceforth *Annual Report*) T. D. Dey Anglo-Saxon Press, 1899, p. 19.

[9] *Ibid.* p. 18.

to the correct path, "not leaving it to itself, but directing it perpetually from the very first, and attaining our end as it were by mechanical aid".[10] Comte, too, saw in positivist science the true moral force of social and political life.[11] In fact in the post-Enlightenment view of the world, the sciences of nature became the paradigm of 'correct' 'rational' knowledge in all aspects of life. At the same time, the Baconian principles stressed man's *control* over nature. The appropriation of nature to serve human interests was directly related to a nation's resources and prosperity.

Such ideas greatly influenced 19th century, Indian intellectuals. Bacon's claims to absolute unique truth was accepted as legitimate. Ram Mohan Roy expressed his faith in Bacon's method as the true guiding spirit of modern life.[12] For Mahendralal Sircar, the appeal of science was similar. Moral laws by themselves were obscure could lead to scepticism; on the other hand physical laws were 'verifiable', scientific phenomenon were capable of reproduction by an arrangement of their causal conditions and left no scope for scepticism. It thus provided the 'unchallengable basis on which the human mind can take its stand for positive certainty in all its investigation".[13] Physical science was a superior form of knowledge because only it could convince the human mind about the "unalterable relationship between cause and effect, with the idea of law pervading the universe. Thus initiated the mind stakes off for ever all the ideas of chance and caprice and chaos from the government of the universe as false and mischievous, having no basis in living reality".[14] Sircar further confirmed the Baconian influence in his thought in his description of the advent of science as a great conquest over nature:

> ...This world is ablaze with their light, and the merest tyro can descent on the marvels man has wrought by the aid of that light; how from the humble position of minister and interpreter he has rises to the sublime rank of master of Nature. And there does not appear to be any limits to

[10] Bajaj, *op. cit.*, p. 28.
[11] Forbes, *op. cit.*, p. 6.
[12] Ray, *Life and Experiences of a Bengali Chemist*, pp.140-141..
[13] *Annual Report*, 1878, p. 17.
[14] *Ibid.*, p. 16.

our knowledge and consequently to our conquests over her vast domain...[15]

The doctor saw in science the true form of knowledge, a civilization in which men could achieve control over their minds and their environment. He placed his "sincere faith in the capability of the physical science to act as the firm and solid basis of the development and regeneration of man's moral and spiritual nature..."[16]

In many ways contemporary India represented everything that was opposed to modern, rational, progressive ideas to Sircar. The greatest obstacle here was the lack of a truly scientific temperament. Sircar like his contemporary Bankim, explained the differences between the East and the West in terms of culture. Europe was equipped with a rational, progressive culture. Contemporary Hindu culture constituted the greatest problem. Its greatest evils were traditional orthodoxy, polytheism, idolatry and the priesthood, none of which he found compatible with the scientific spirit.

Referring to the dominance of the Hindu priests, "the most crafty, the most selfish and the most demoralised of any in the world",[17] he said.

> It is not right that any man, far less that so many millions of men for generations without number, should be kept down in false and unworthy belief and thus deprived from the elevating and regenerating influence of the first and highest- Truth. If for no other reason, pre-eminently for this, is it the supreme duty of every devout student of nature to endeavour his best to introduce a knowledge of the physical science amongst the people of this country.[18]

His opinion of idolatrous and pantheistic beliefs which "must receive their death blow from such study" of the sciences was similar.[19]

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[15] Sircar, "On the Necessity of National Support to an Institution for the Cultivation of the Physical Science by the Native of India", February , 1872, in Sircar, *Indian Association,* p. 16.
[16] *Annual Report*, 1902, p. 20.
[17] Sircar, *Moral Influences of Physical Science*, P. Sircar Anglo-Sanskrit Press, 1892, p. 19.
[18] *Ibid.*
[19] *Ibid.*

Under such circumstances, Sircar argued that the pursuit of 'true' knowledge was inconceivable, as the human mind became idle and wandered in useless speculation, while knowledge become inward looking,

> The Hindu mind, thanks to this religion which has been swaying it for centuries without number, and thanks no less to its other surroundings, has become more of a speculative than of a practical character singularly deficient in patient industry to observe materials, too prone to hasty generalisation, depending more upon its own inspirations than upon outward facts.[20]

Thus, Indian studies of nature and natural laws were superficial and rudimentary for Sircar, for they diverted the human mind from the right path towards 'unnecessary' 'unsolvable' pursuits, "And necessarily they had in many cases to go astray and waste their energies in problems which are unsolvable, and attempted to formulate and maintain propositions which became stereotyped into dogmas, a blind faith."[21] (emphasis mine). It was this sort of intellectual exercise which was the "cause of the arrest of all progress in India".[22]

Sircar was of the opinion that Indian scientific knowledge was merely a "chaotic mass of crude and undigested and unfounded opinion on all subjects".[83] He was very clear that science was alien to Indian culture. Physical science was of modern European origin.[23] "...I believe I am not committing any unpardonably unpatriotic sin when I say that physical science did not exist in our country even in days of its greatest glory - of its loftiest intellectual achievements. And certainly it does not exist in the present day. It must be introduced from the west.."[24]

While replying to criticism of his strong views Sircar argued how that even the notion of scientific knowledge was alien to Indian tradition. The very conditions of scientific thought did not exist in a society devoted to idolatrous,

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[20] Sircar, "On the Desirability...", pp. 4--5

[21] *Annual Report*, 1901, p. 26.

[22] *Ibid.*

[23] Sircar, "On the Desirability ...," p. 4.

[24] *Annual Report*, May, 29, 1893, pp. 17-18.

and speculative pursuits.

> I admit for the sake of argument that there was science even in a high state of cultivation. But I beg leave to ask where are the traces of such a state of things? Certainly they are not to be found in the voluminous literature that has come down to us as heritage. To characterise as science the crude speculations about nature and her laws contained in this literature, speculations which could not go beyond the five elements, would be to show the grossest ignorance of science and of the methods of scientific enquiry.[25]

In another instance he pointed out that Asia to develop a material culture. He believed that originally all arts were handicrafts devoid of scientific knowledge. At a critical juncture, Europe systematized empirical knowledge into science, introducing machines and making production cheaper. In this regard, India and the rest of Asia lagged behind.

> In the present day the difference between one nation and another in the scale of civilization depends upon the amount of cultivation of these arts or rather of the sciences on which they are founded. The backwardness of our country, indeed of Asia generally, notwithstanding the existence of arts as yet inimitable, as accounted for by the want of cultivation of these arts and sciences.[26]

Thus, for Sircar, the 'cultivation' of science and the arts was crucial for development. The mere practice and use of technology was not enough. It had to be studied, developed further and turned to an experimental research culture. The lack of a scientific temperament in Asia's past was the cause of its later suffering.

But Sircar was never seriously concerned about the Indian past. Troubled by the cultural distance between the contemporary East and the West, his attention was on the present- on "whether are we to remain contented with our ignorance of it".[27] His logic of 'cultivation' had greater potential in the nineteenth century. The choice to him was clear. India had to adopt science because such studies leave "little room for dogmatism" as any one could satisfy

[25] *Ibid.*, 1899, pp. 17-18.
[26] *Ibid.*, 1900, pp. 24- 25.
[27] *Ibid.*, 1899, p. 18.

himself about the facts by "observation and experiment". For this science India had to look to the West;

> It (Science) must be introduced from the west. The natives of India, if they want to take rank with the civilized nations of the world, if they must escape from the ignominy of being morally and intellectually effaced from the face of the globe, must do what these nations are doing, must take to cultivation of science which will elevate them from the position of slaves to the rank and dignity of the masters of Nature".[28]

Sircar's nationalism was to cultivate science, undergo moral regeneration and to become 'master of nature'. The two had to go together as only science could provide the nation its required moral strength as well as its material development. In Sircar's mind , there was no other choice for Indian nationalism. It had to adopt science as its religion if it intended to survive in the 'race of nations', "There is no *status quo* in the universe. There is progression and retrogression. The chief determining factor of progress is now and will always remain science. The amount of its cultivation in any country will thus be the chief index not only of its civilisation but of its power of maintaining its existence,.."[29]

With science at its core, Sircar's nationalism was a vigorous exercise of power for existence, progress and the conquest of nature. The thrust of Sircar's ideas was entirely moral; crucial to his thought was the morally regenerating inspiration of science. Material development could only be brought about after such regeneration was achieved. This moral content, of this mission was obvious in his project, IACS, which aimed at, "...fulfilling functions of the moral. noble and elevating character, being no less than remodelling the Asiatic mind, leading it from airy regions of vain and mystifying speculation to the solid grounds of nature's facts and laws."[30]

The countries which practised science, thus, were mature and self-sufficient. The rest, unable to master that knowledge, were still immature and

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[28] *Ibid.*, 1893, p.18.
[29] *Ibid.* , 1899, p. 19.
[30] *Ibid., 1887, p. 15.*

dependent, 'idle' and 'childlike', unable to exploit and control their surroundings. Due to the lack of this scientific knowledge, Indians, in spite of the contact with west, remained, "unproductive recipients" of the products of science.[31] As Sircar was fond of saying, "... there is an immense difference between the civilized man and the man happening to live in civilized times, between the man of science and the man whom accident has placed in the era of science...".[32]

Sircar wanted the Indian to become 'civilized man' and a 'man of science'. That was the moral content of his nationalism. According to him, Indians had remained "idle spectators of the wonders presented to our view by what we vaguely understand as science." Little had they realised that science was "in reality the offspring of the human brain brought forth in *much travail*".[33] (emphasis mine). If Indians were to become men of science, they would, instead of being "idle spectators" have to catch up with the western mind. To do that they would have to practise science themselves. In Sircar's words, Indians would have to 'cultivate' science themselves, to ensure that the "Hindu mind can be developed to its full proportion".[34] In his very first article in 1869, he argued:

> The kind of knowledge which is best calculated to remove prejudice and spirit of intolerance from the mind is what passes by the name of the physical sciences..[35]
>
> ...
>
> The best method, and under the present circumstances the only method, that we conceive of, by which the people of India can be essentially improved, by which the Hindu mind can be developed to its full proportion, is .. by the cultivation of the Physical Science. The great defects, inherent and acquired, which we have pointed out as characteristic of the Hindu mind in general of the present day, can only be remedied by the training which results from the investigation of natural phenomena.[36]

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[31] Sircar, "On the Necessity...", p. 25.
[32] *Ibid.*
[33] *Ibid.*
[34] Sircar, "On the Desirability...", p. 7.
[35] *Ibid.*, p.3.
[36] *Ibid.*, p. 7

Only cultivation of science could challenge the backwardness of Indian minds. As Sircar suggested at the Annual meeting of 1893,

> ...Hence the cultivation of science must form an indispensable element of our national culture, as it is in all civilised countries... It is with this view, Gentlemen, that I have striven all my life long to induce my countrymen, Hindu and Mahometan alike, and any other race of people who pride in the name of India, to unite in the holy bonds of fraternal sympathy and love for the common, worthy cause of mutual advancement by the at present best means, and I might say, the only means, within human reach, namely, the cultivation of the physical sciences.[37]

Although diffusion of scientific knowledge was also one of the motto of the IACS, original research by Indians was always considered its higher, more sacred objective. Discussing the objective of his institute, he made this hierarchy of priorities explicit :

> The object, with which this Association was founded is not simply the diffusion of a knowledge of the truths of science discovered elsewhere. This is but one of its object, and a very inferior and subordinate one. The other, the higher, the primary object is... which was adopted in the very first resolution founding the Association, viz., "to enable the Natives of India to cultivate Science in all its departments with a view to its advancement by original research, and (as will necessarily follow) with a view to its varied application to the arts and comforts of life".[38]

But Sircar's emphasis on the importance of cultivation of science betrays another significant aspect of his thoughts. For him, Indians as idle "unproductive recipients" represented a child like state of existence. The 'cultivation' of science was a learning process, a 'man-making' project. It was a path through which men could turn into mature adults after childhood and adolescence. Sircar's nationalism, based on science was based on such notions of growth. Consequently, his writings are full of adult-child metaphors.

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[37] *Annual Report*, 1893, p. 18.
[38] *Ibid.*, p. 22.

Research and Adulthood

Mahendralal Sircar once remarked

> For that direct self-preservation , or the maintenance of life and health, the all important knowledge is - Science. For that indirect self-preservation which we call gaining livelihood, the knowledge of the greatest value is - Science. For the discharge of *parental* function the proper guidance is to be found only in - Science.[39] (emphasis mine)

The paternalism of science mentioned above is a reflection of the predominant western rational attitude towards the colonized world. Edward Said has described how through western rational explanations, Europe appeared as the secular creator of a new world, as God had created the older one.[40] In a way it reflected the general paternalism of entire European colonialism vis-à-vis the Orient. The Colonized peoples were seen as children who needed to mature to become responsible 'men' or 'citizens'. As Ashis Nandy indicates, colonialism picked up contemporary European attitude towards childhood as a "blank slate on which adults must write their moral codes" and drew a new parallel between primitivism and childhood.[41] In such a scheme the colonized always appeared as 'children' which term was coterminous with primitive or a 'blank slate'. Colonialism was seen as a necessary function of Europeans to help the helpless children grow towards higher morality, adulthood and maturity. Western knowledge was supposed to play the patronising, paternalistic role in this project . Nandy shows how 19th century Indian intellectuals like Bankim, Vidyasagar and Madhusudan Datta functioned within this paradigm while attempting in their various ways to make 'adult men' out of Indians.

To Sircar also, India although an old civilization, its lack of a scientific tradition, restricted it to a state of adolescence. The ability to 'cultivate' science to him was the precondition to becoming an adult. That is why he believed that the deficiency of a 'science culture' in India could not be met by merely teaching

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[39] *Ibid.*, 1899, p. 18.
[40] Edward Said, *Orientalism*, R. K. P: London and Henely, 1978, p. 121.
[41] Nandy, *Intimate Enemy*, p.11-18.

science in schools. Schools were for children where the pupil was only taught. What was needed was an association to encourage research in science, because only scientific research would help in the development f children into men.

> ...In schools pupils can never rise to the state of practical workers in science, so as to be able to carry on independent investigation, not because of any fault in the psychology of the pupils themselves, but because such a thing is impossible in *statu pupillaris*. Men must continually be at a subject , observing and experimenting, before he can acquire that knowledge of it which will enable him to feel his own deficiencies in the branch of science which he has made his speciality, - before indeed he can engage with any hope of success in researches which will improve both himself and his science.[42]

Elsewhere Sircar made clear the 'man making' aims of his Association, when he asserted that "...We have, I told you, no scientific men at all, and we want to create them- train men in science".[43] Father Lafont, his old friend and fellow founder of IACS, shared these views. He reacted strongly to suggestions that the Institution was 'merely' an educational one. He claimed the higher status of a 'scientific institution' for IACS, "it was not a school, it was a scientific institution in which modern discoveries in science were promulgated".[44]

It was in this same spirit that Sircar thought of university education as insufficient for national regeneration. He always resisted the affiliation of the IACS to Calcutta University which might have simply turned it into a college. Universities he believed, only taught science thus its scope was limited and could not fulfil the great task of making men;

> It is true, that our universities are turning out at high pressure and speed graduates in the various faculties, - masters and bachelors, - by hundreds and thousands. But if we are to judge them by the only and infallible test of - "by their fruits ye shall know them"- how would they stand? How would they compare with their brethren of Europe and America?[45]

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[42] First meeting of Subscribers at the Senate Hall, Calcutta University, 4 April, 1875, cited in Chittabrata Palit, "Mahendralal Sircar, 1833-1904: The Quest for National Science", in Deepak Kumar (Ed.), *Science and Empire: Essays in the Indian Context*, Delhi, 1991, p. 156.

[43] "On the Necessities ..", p. 33.

[44] Arun Kumar Biswas, "Revered Father Eugene Lafont and the Scientific Activity of St. Xavier's College", *Indian Journal of History of Science*, vol. 129, no. 1, 1994, p. 84.

[45] *Annual Report*, 1898,p. 15.

Sircar insisted that universities were only the first stage; Here students were "merely to learn parrot-like what other nations are teaching is to abdicate our position as an intellectual people, as a member of the republican of letters".[46] Sircar's Association too had taken up teaching science but that was because at that point it was almost non-existent in universities. His hoped that once colleges developed the art of the teaching of science, IACS could focus on its primary objective; " then its only *raison de etre* will be advancement of science by original research. If it cannot be made to fulfil that object, it would be better that it should cease to exist."[47] Sircar was always uncomfortable with the popular demonstration-lectures at IACS as they generally gave the wrong impression that, "attendance at these lectures will convert the audience into full-blown men of science and discovery will follow after discovery as in Europe and America,"[48] 'Man - making', Sircar believed, was a much more arduous process. It needed active participation, effort, originality and judgement on the part of the individuals involved.

Sircar's ideas in this regard had reached a consensus among his colleagues at IACS. When a proposal came up in 1893 to affiliate IACS to the Calcutta University , all the members except Lafont opposed it as a 'degradation' of the prestige of the Association.[49] For, Reverend Lafont, a missionary and a teacher at St. Xaviers, the diffusion of knowledge always had a separate appeal. He successfully convinced Sircar to open the lectures of the Institute for students of First Arts Examination. Sircar, faced with the reality that not much original research was in any case being conducted at the IACS, chose to be pragmatic. He realised after some initial hesitations that, "it would be no derogation of its (IACS's) dignity to tell the University that the lecture which were being delivered within its walls would fully prepare students for the First Arts Examination."[50]

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[46] *Ibid.*, p. 16.
[47] *Ibid.*, 1901, p. 21.
[48] *Ibid.* 1893, p. 24.
[49] *Ibid.* 1900, p. 17.
[50] *Ibid.* pp. 17-18.

It was due to such an Orientation that we find in Sircar a great advocate of fundamental science. He felt that research in the fundamentals of science could improve the moral standards of human beings and this served the greatest purpose to humanity. His position was clarified in his debate with the Indian League on turning IACS into a technical school. While Sircar and his friends were preparing the blueprint for the Association, a scheme for a technical institution was initiated by the Indian League- a semi- political organisation. The objective of the League was to combine scientific instruction with practical training, and the drilling of men in manual and mechanical industries, on the model of Technischen Hochsulen of Germany and Switzerland.

Sircar's plan for the 'cultivation' of science was criticised by the League as being premature and intended merely for intellectual pleasure. Suggestions were made for the amalgamation of both projects into a single institution undertaking teaching in science as well as instruction in mechanical arts. The Lieutenant Governor General Richard Temple was also showed sympathetic towards such a plan.[51] The third meeting of the subscribers at the Senate Hall in 1876, saw two opposing camps vigorously arguing their positions. On Sircar's side were Father Lafont, Raja Ramnath Tagore, Dr. Rajendra Lal Mitra, babu, Digambar Mitter, Raja Jatindra Mohan Tagore and Keshab Chandra Sen. Sambhu Chandra Mukherjee, Kalimohan Das and Reverend K. M. Bannerjee defended The League's position.[52]

Reverend Bannerjee, Chairman of the League talked of a "combination of scientific teaching with practical training", and "utilizing the discoveries already made before aspiring after such discoveries".[53] He also accused Sircar of "Soaring aloft, without looking beneath".[54] Sambhunath Chandra Mukherjee,

[51] Rai Chunilal Bose Bahadur, "The Science Association and its Founder", *Ibid.*, 1918, pp. 37-38.
[52] Kumar, *Science and the Raj*, pp. 199-200.
[53] Palit, *op. cit.*, p. 157.
[54] Kumar, *Science and the Raj*, p. 200.

described the project of the IACS as, "unnecessary luxury, an anachronism and an anomaly - the scheme involved a waste."[55]

A strong support for Sircar's position came from the Orientalist, Rajendralal Mitra. His arguments combined the earlier Asiatic Society notion of a 'pure', science, with the 'Man-making' project of nationalism.

> Science had a higher and nobler claim than the narrow, utilitarian, Benthamite one.. It was the most powerful lever for progress, for the advancement of civilization, for ennobling the mind of man. Do not confound Science with technical education in the industrial arts .... let every step of science education be explained by experiments, for science to be effectually learnt should be learnt in the laboratory: but do not attempt to make your Institution a school of technical education in the industrial arts under the misnomer of practical Science.[56]

Father Lafont also stressed the need of fundamental science for Indians to become self-sufficient and independent. The League, he alleged, wanted to, "...transform the Hindus into a number of mechanics requiring for ever European supervision whereas Dr. Sircar's object was to emancipate in the long run his countrymen from this humiliating bondage".[57]

Mahendralal Sircar's son and successor Amrita Lal Sircar took up the cause of fundamental science with greater zeal. Taking over the Association at the height of the swadeshi movement in 1904/05 he criticised those whose "cry is for industry" stressing the fallacy of "applied research".[58] He epitomised the ethics of disinterested fundamental research when he quoted a Paris journal to define the role of scientists,

> A little body of men , forsaking the world and the things of the world, had gathered together under the compulsion of a great idea. They had given up the rivalries and personal interest of ordinary men, and sharing their goods and their work, they lived in austere devotion to science, finding no sacrifice of health or money, or what men call pleasure, too

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[55] *Ibid.*
[56] *A Century*, p. 11.
[57] Palit, *op. cit.*, p. 157- 158.
[58] *Annual Report*, 1905, p. 21.

great for common object....[59]

Somewhere, thus, the attitudes towards science of the Asiatic Society and the IACS met, although through very different routes. The 'man-making' project and purity of science necessarily had to go together. To that extent there were certain shared values between IACS's nationalist definition of science and the romantic one of the Asiatic Society.

It was for such an Orientation, that the IACS concentrated its teachings on "pure science". The first lectures were by Dr. Sircar and Reverend Father Lafont on Physics, Rai Tara Prasanna on chemistry and Reverend A. de Penaranda on Astronomy. Simultaneously, the laboratory was built.[60] When Father Lafont left for France due to ill-health, a sum of Rs.4000/- was given to him for importing an assortment of instruments and apparatus for illustrating lectures on thermotics, acoustics, electricity and optics from France. In 1878 a large number of new instruments arrived, including a sympalmograph, a phonograph, and a Caitellet's machine for the liquefaction of oxygen. In the next few years further physics and chemistry apparatus arrived.[61] Father Lafont continued his lectures in Physics on light, general physics and sound until 1893. After Lafont, Rajendra Nath Chatterjee taught optics and general physics.[62]

Dr. Sircar began with lectures on static and dynamic electricity, magnetism and heat. In 1885, J. C. Bose, Professor of Physics, Presidency College, started taking practical classes in Physics including experiments performed by the students themselves, on convulsions of fishes spruced by contact of dissimilar metals, Oersted's experiments and polarization of currents. In 1887, for a brief period, Ashutosh Mukherjee delivered lectures on physical optics, mathematical physics and pure mathematics. He surveyed some of the most recent areas of late 19th century physics like Mac-Cullagh's theory of

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[59] *Ibid.* p. 23.
[60] *A Century*, p. 15.
[61] *Ibid.*
[62] *Ibid.* p. 16.

metallic reflection, Ray-Leigh's theory of colour of the sky and Maxwell's dynamical theory of the electromagnetic field.[63] An attempt was made to give the students an idea of the various fields of scientific thought and to introduce them to some of the recent trends in such studies.

At first attendance at the lectures was limited to one or two dozen people. Their popularity gradually increased and by 1887, numbers jumped to over three hundred people. With the introduction of 'B' courses in the University curriculum, which made provision for scientific subjects, students from other colleges found it profitable to attend lectures at the Association. Students of the Calcutta Medical College, women students from La Martiniere Institution and Doveton College regularly attended these lectures and participated in the practical demonstration classes. From 1891, attendance started falling because of the reorganisation of science departments in Calcutta University. Students found the lectures on pure science and recent discoveries designed to encourage research, not suitable to college courses. Later, when IACS was associated to the Calcutta University, students began to use the association's laboratory.[64]

Questions of morality, nation building and cultivation of science had set one of the central agendas of the IACS. It had structured its orientation, ethics as well as the nature of its courses. The other half of IACS's nationalistic agenda was the search for self-reliance which provided the crux of its nationalist identity.

'Self-Reliance' for the Adolescent

Mahendralal Sircar was very clear that his institute was to have a 'national' character, when he said, "there must be national-support to this national work. This can only be secured by an organisation which must be national in its character".[65] This 'national character' did not originate from a critique of colonialism. I show later, how Sircar's devotion to the fundamental

[63] *Ibid.*
[64] *Ibid.* pp. 20-21.
[65] *Annual Report,* 1893, p. 18.

principles of post -enlightenment and Baconian science, made it impossible to criticise colonialism. He essentially focused on contemporary (Hindu) culture. His institute reflected Sircar's reach for self-reliance of Indians in areas of scientific research,

> ....We should endeavour to carry on the work with our own efforts, unaided by Government, perhaps more properly speaking, without seeking its aid. Now this does not mean that we will not accept any aid from that quarter if it comes to us unasked, and unhampered with conditions and restrictions, excepting the all importance condition of the continuance of the Association. Let me not be misunderstood. I want freedom for the institution. I want it to be entirely under our own management and control. I want it to be solely native and purely national.[66]

How did this search for self-reliance articulate itself in a 'freedom' for an institution, "entirely under our own management and control"? Why was the need felt to develop an independent base of Indian scientific research? For an answer let us delve further into Sircar's arguments. He explained that the independent status of the IACS was, "to make my countrymen, in the matters of science - cultivation at least, self-reliant", to help them "master the elementary principles of science unaided, that is except with the aid derived from books and instruments".[67] He stressed that the Association would be open to any aid from the government which would, "not interfere with the independence of the Association as a national Institution. Such independence is essential to the very life of the Institution as calculated to engender the spirit of self-reliance which has well-nigh become extinct."[68] The spirit of self-reliance is part of Sircar's 'man-making' project. thought that to become responsible men, all Indians must develop the spirit of self-reliance, which unfortunately in India had "well-nigh become extinct." And what better way could there be to do so other than practising it in science- the great moral force? To that extent we can expect the elements of adult-child, mother-child relationships in the project. This is apparent

[66] *A Century*, p. 8.
[67] Sircar, "A Sketch of the Scheme of the Science Association", in Sircar, *Indian Association.*, p. 71.
[68] *Hindu Patriot*, June 1, 1891, p. XXXV .

when Sircar talks of the advantages of the British rule to India,

> Of these favourable circumstances the most efficient is SELF RELIANCE. This we have not yet learned. For any move tending to our own prosperity we expect always to be helped by the Government. If the Government were to do everything for us, we shall never do anything for ourselves. We must be *weaned* from this sort of dependence upon others, just as a *baby is weaned from the mother's breast*".(emphasis mine)[69]

Sircar's metaphors are striking. British rule performed the role of the mother who blessed India with western science, while Indians were children learning to suckle the virtues of science from her. For the children to grow up they had to be 'weaned' by instilling in them qualities of self-reliance to pursue science on their own. Thus, the dual project of establishing an independent research institution for Indian science could ensure both organisational and intellectual maturity, "And we wish that the Institution be entirely under native management and control. We say this not out of vanity but simply that we may begin to learn the value of self -reliance in matters in which we may do it without any serious risk."[70]

The search for 'freedom' from government, however, was not an anti-colonial sentiment. It sought, rather, to instil a sense of responsibility among Indians who had become unnecessarily dependent on the government. This was the bane of Indian nationhood.

> ....A blind and slavish dependence upon the government and idle and passive murmuring whenever government fails to accomplish anything, are all that we are capable of. They always shirk the responsibility of any good and great undertaking, and consequently can never have an adequate idea of the privilege of such responsibility and the pleasure attendant there upon....[71]

Here we see Sircar's notions assuming more political shape. In his scheme, independent scientific research was to be the crux of the Indian search

[69] "On the Desirability...", p. 6.
[70] *Ibid.* p. 8.
[71] "On the Necessity ...", p. 37.

for self-reliance in the political and economic arena. The phrase "idle and passive murmuring" indicate Sircar's attitude towards the nascent moderate political nationalism of his times. As mentioned earlier, he always felt that nationalism could be achieved far more effectively through the practice of science than through 'platform blustering". He equated his self-reliance in science with the ethics of political self-government in his 1899 speech at the Association Annual meeting,

> We are justly desirous of having the privilege of self-government. We cannot have better fields than these (cultivating science independently) for the exercise of the virtue of self-reliance and for the display of our fitness for self-government for here we shall have help- from all quarters and hindrance from none, if we only know to *help ourselves.* (emphasis mine).[72]

One way to achieve self-reliance was, as shown above, to focus on original research in science. The second was through funding, necessary, because science was expensive and as Sircar understood well enough, "men have stomachs as well as minds. The mind must have leisure to think that it may think with any advantage, and this can only be secured by providing the demands of the stomach".[73] In his scheme funding had to come from Indians, both to make the IACS and the Indians 'self-reliant'. In the Annual meeting of 1887, he asked, "But where are the funds to come from? Your Honour must have observed, that it has been my endeavour all along to make the Institution purely and entirely a national one ... I therefore expect and wish that the funds should come from my countrymen,..."[74]

On another occasion, Sircar discussed his ideas of the 'freedom' of scientific research,

> And the only way, which I can think of by which this (growth of IACS) may be effected is to set free and properly direct the two forms of energy that are to be found in the country, partly latent and party working or

[72] *Annual Report,* 1899, p. 20.
[73] *A Century,* p. 9.
[74] *Annual Report,* 1887, p. 15.

> rather, to speak in more appropriate terms, being dissipated in wrong directions, I mean the energy of intellect and the energy of hoarded wealth.[75]

This 'energy of hoarded wealth' was with rich Indians. Sircar's appeal for funds was mainly to them. Citing the example of Pearson and Carnegie of USA, he added.

> May I not hope that the happy contagion will spread in our country, and bring under its blessed influence her patriotic sons, who will thus be enabled by the proper use of their wealth to wipe off for ever the stigma that has been cast by the poet upon her as being a land of "barbaric pearl and gold".[76]

He urged rich Indians not to "squander whatever wealth you possess in idle amusements", while donating money to the IACS would surely prove their "enlightened liberality for the amelioration and elevation of your country."[77] That would be their sacred contribution to nationalism,

> There is I believe potential energy in the shape of hoarded wealth. It has only to be set free for this purpose to be transformed into kinetic energy of the highest kind, because intellectual and moral, to raise your country from its present degraded position to the high level of the highest intellectual nation on earth. The possessors of this wealth have only to be awakened to their true interests and then things will be done.[78]

Such appeals based themselves on the 'moral and intellectual' aspect of 'nation-building'. However, Sircar also had an innate belief in the socialist distribution of "hoarded wealth".

> ....The money ought, in my humble opinion, to come from the rich whose wealth is ultimately traceable to the sweat of the brow of the poor. In contributing towards the advancement of science the discoveries of which tend more for their benefit than the benefit of the poor, the rich only repay a double debt which they are bound in all fairness to pay.[79]

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[75] *Ibid.* 1891, pp. 26-27.
[76] *Ibid.* 1901, p. 31.
[77] *Ibid.* 1902, p. 27.
[78] *Ibid.* p. 28.
[79] *Ibid.* 1898, p. 25.

The costs of running the various laboratories of the world were placed before the public in comparison to that available to the IACS, to emphasise the huge gap in the two.[80] The most important need Sircar felt was to have paid professorships as it was important not to depend only on honorary lectures.[81] Almost all of Sircar's speeches were accompanied by an appeal for funds to this cause. But in reality, apart from Jamshedji Tata very few were coming forward. Others showed little interest. Sircar's moral and socialist appeals made little sense to them. There upon, Sircar reacted sharply, feeling let down by his countrymen protesting against the "positive antagonism towards the Association".[82]

> ...Strange as it may appear, it is a fact and a fact that remains a blot in the national character of the present time that the Association, though struggling for existence for upwards a quarter of a century, is ignored and even looked down upon with cold disdain by those whom it gave not only the heartiest welcome but gave all the help and encouragement in its power to work within the walls...[83]

He observed that the wealthy sections of Indians were more interested in donating money to built a memorial to the late Queen Victoria. Hoping to lure them to the cause of scientific research, he offered to endow a chair in Queen Victoria's name. However, even that failed to take-off.[84] Frustrated with such indifference, the doctor exclaimed , "oh, that they would understand,... that there cannot be a worthier object of charitable endowment than learning..."[85]

Sircar's reactions were violent because for him here the Indian self-reliance and thus Indian adulthood were at stake. Seemingly, Indians had failed to stand up on their own feet, and become 'men'. What frustrated Sircar most was the realisation that very little fundamental research was being actually undertaken by young Indians in his Association. This indifference to the fundamentals of

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[80] *Ibid.* p. 23.
[81] *Ibid.* 1900, p. 19.
[82] *Ibid.* 1898, pp. 23-24.
[83] *Ibid.*
[84] *Ibid.* 1901, p. 25 and p. 30 also see *Ibid.*, 1902, p. 18.
[85] *Ibid.* 1902, p. 18.

science, he felt, reflected Indian moral immaturity and thus the fallacy of Indian nationhood. He called the lack of enthusiasm to 'cultivate' science a - 'conceit'.[86] In the last couple of years of his life, Sircar became increasingly restless and frustrated at the state of affairs. His anger was directed particularly towards the young students, "And for this, pardon me, if I tell you, you are partly to blame... not a single student either during college life or after, has come forward, ever since the foundation of the Association, *to cultivate science for the sake of science.*"[87]

In his last speech to the Annual meeting of the IACS he talked of how he felt he had 'wasted' his life:

> ...I do not know how to account for this apathy of our people towards the cultivation of science. And therefore I am forced to confess that I made a mistake in starting the project of founding a Science Association at all, and that I have wasted a life, as I have told you, in attempting to make it a national institution.[88]

To Sircar's despair he felt the project had not even taken-off. He found the task to be too imposing if not impossible:

> ...But unless this be the faith of all my countrymen, or at least of our leaders, no amount of faith of a single individual will avail. Strangely enough, the experience of a whole life compels me to say that faith in the elevating and regenerating influence of science, if it does exist in the mind of our community, has not grown yet to bear fruit. Oye! Gentlemen, pardon me, if I question if it is a living faith at all.[89]

The main pillars of Mahendralal Sircar's thought were fundamental research, moral values and self-reliance. However, nationalism in a colonial context had to refer to British rule. Indian nationalism reacted to colonial rule in various ways from feelings of gratitude to partnership to positive antagonism. A study of the attitude of the IACS towards the colonial state will complete our understanding of Sircar's 'scientific' nationalism.

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[86] *Ibid.* 1901, p. 33.
[87] *Ibid.* 1901, p. 32.
[88] *Ibid.* 1902, p.19.
[89] *Ibid.* 1901, p. 21.

Sircar's IACS and the British Rule

Sircar put forward a critique of the colonial state's apathy towards scientific research in India, "...I say with deep regret that our government has hitherto offered no opportunity, nor offered any encouragement to the pursuit of science by the natives of India...."[90]

He was also critical of the government's educational policy, particularly in the universities. In 1902 he questioned the University Commission's decision to introduce higher fees in education, to restrict science education to a few selected colleges and to abolish second-grade colleges teaching up to F. A. standards.[91]

Sircar's criticism has to be seen in the proper perspective, for it interrogated the performance of the colonial government, or the lack of it, in certain fields. He did not challenge the very basis of colonialism; its economic and political roots, did not disturb Sircar. Second, Sircar found many differences between its policies and that of the western nation-states. We must remember here that the European scientists of the Asiatic Society had similar complaints.

Sircar did not attempt to distance himself from the colonial regime, as was clear when he appealed to governor-general Woodburn to convince Indians to donate more money for this 'great cause.'[92] Moreover, Sircar was not opposed to British aid. In the Resolution 8 of the Plan of the Association, Sircar made it clear that he was open to European assistance in terms of teaching as well as funds, even if that might be "charged with departing from the quintessence of my scheme, which is to make my countrymen, in the matters of science cultivation at least, self-reliant".[93] This was necessary because "we must admit we have to

[90] Palit, *op. cit.*, p. 155.
[91] *Annual Report*, 1902, pp. 22-27.
[92] *Ibid.* 1899, pp. 25-26.

[93] "A Sketch..", p. 71.

learn even the very rudiments".[94]

Again in Resolution 18, he made clear his expectations from the government for his 'noble' cause which any enlightened rule was ought to promote;

> ...A government that professes to rule by the laws of justice, and by all requirements of advancing civilization, ought not merely to foster such a sense of duty, but cultivate and develop it. We are fortunate to be under such a government as this, and therefore we sanguinely expect aid from it.[95]

Mahendralal was practical enough to realise that the task he had undertaken was difficult and that British aid was necessary even for his brand of self-reliance;

> At the same time it must not be forgotten that it is impossible in the present day to cultivate science in all its branches and to the fullest without aid and encouragement from those who have all the resources of the country at their command. ....Government has already done much for the Association by its moral support, and by acquiring the land for it on which its premises stand; and it can do much more in a variety of other ways.[96]

Sircar was thinking of two categories of help. One was the employment of indigenous men of science in its services and the recognition of institutions like the IACS. Second, he wished the colonial state would provide money and other aid to such institutions.[97]

However, the significant condition that Sircar put on such aid was that it would not interfere with the independence of the Association, "...All this (if) government can do without touching the independence of the Association, the Association will make much more rapid progress that it can with its own unaided resources."[98]

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[94] *Ibid.*
[95] *Ibid.* p. 77.
[96] *Hindu Patriot*, June 1, 1891, p.XXXV.
[97] *Annual Report*, 1898, p. 25.
[98] *Hindu Patriot*, June 1, 1891, p.XXXV.

Sircar emphasised the independence of the IACS, because of his search for self-reliance and self-sufficiency in scientific research. The other and more interesting motive was the scientist's search for insulation from outside influence during scientific research. We have already seen how a scientific community committed to 'pure' scientific knowledge sought to shield itself from external control. This was the case with the Asiatic Society. The IACS, which shared similar ethics of scientific knowledge as a pursuit of the 'pure' with the Asiatic Society, was looking for similar immunity.

A couple of years after Sircar's death in Amritalal Sircar's words it becomes evident how the two pillars, whole concept of 'cultivation' of the fundamentals of science and 'self-reliance' of the IACS were linked to the idea of 'independence'. Amritalal expressed the fear that if the Association gave up its independence and became affiliated to the government, Indians would never become self-reliant, "We shall never have the courage to stand on our legs again."[99]

Clearly, such 'independence' had no linkages with political emancipation. It was a search for scientific insulation. Reacting against suggestions of grants, affiliations to the government and acceptance of the regulations of the universities he argued that such a step would hamper scientific research,

> If the grant be unconditional, then why not take it to utilise in any way you like, rather than to equip yourselves for the petty tyrannies of University Regulations, where the freedom of professors and students and also the freedom of constructing your tables and chairs and rooms, are sacrificed....[100]

In his opinion true research was not possible in Universities under pre-existing government regulations. There, teaching occurred within a structured course and syllabus. Research must be free from such control, "If we once fall from our higher pedestal of independence there will be no chance of recovery,

[99] *Annual Report,* 1907, pp. 34-35.
[100] *Ibid.*, p. 35

and this noble institution will be converted into an ordinary school."[101]

That Amritalal's ideas had wide acceptance in the IASC can be seen in other speeches. Mr. Bruhl, one of the members, stressed the importance 'of independence' in his support of Amritalal, "...Let us be entirely independent; let us not be tied by red tape; red tape is as the hangman's tape to scientific research."[102] He even suggested that since the colleges by then had started science teaching and setting up of laboratories on a large scale, the Association should severe ties with the universities and go back to its 'basic' interest, scientific research and short courses of public lectures on recent advances in science.[103]

These apprehensions of losing touch with the 'higher', 'sacred' and 'pure' scientific knowledge show that the two pioneering institutes of scientific research in colonial India, (the Asiatic Society and the IACS) shared similar concerns. Sircar and his colleagues had incorporated the same ideas of dichotomy between scientific research and public life, within an institute, which was, however, focussed largely towards a great public goal 'national regeneration'. The two worlds of the Society and the IACS were thus familiar and yet distant. We shall now focus on how such orientations shaped the relationship of the IACS with British rule.

It was because of Sircar's absolute faith in the virtues of western science that he did not produce a political. economic or even a cultural critique of colonialism. Unlike Bankim, he did not see British rule as 'invasive'. For him it was a positive force within the country bringing about desired cultural and social change. A clear sense of reverence and even gratitude towards the British is unmistakably present in his speeches and writings. He believed that the presence of the British in this country was a great 'advantage' which Indians must utilise for this regeneration,

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[101] *Ibid.*
[102] *Ibid.* p. 39.
[103] *Ibid.* p. 40.

> I am not ignorant of the fact that adverse circumstances for a series of centuries have had a most paralysing influence upon our energies, but these energies, as we have abundant evidence, are not altogether gone beyond recovery, and we have this advantage that we are now given, under a beneficent rule, opportunities for intellectual activity such as never existed even in days of our greatest glory.[104]

His appeal to the British was to fulfil. "the mission for which Providence has appointed them, ...to raise the Indian people to a level with themselves".[105] While asking for aid from the British Sircar suggested that, "To the latter (British people) we doubt not, it will be gratifying to see that we have at last learnt to beg for such noble purposes which we must gratefully set to the credit of their own example..."[106]

Clearly Sircar's reverence for western scientific thought had ruled out scope for any real antagonism towards British rule. The cultural superiority of Western knowledge had confirmed the power equation. India had to eternally feel grateful to the west for having bestowed science on the country.

Gooroo Dass Banarjee, Sircar's friend and colleague in the IACS expressed similar opinions. Using a scientific metaphor in one of his speeches he compared British rule to the sun, giving light, warmth and life to Indian soil.[107] It was due to such sentiments that Amritalal Sircar later took the initiative to help the British in their war efforts during the First World War. Speaking as the Secretary of the IACS he said, "Both man-power and wealth- power of India should be sacrificed for the cause of our benign Government- a government which has given us peace, prosperity, wealth and order".[108] His appeal was mixed with elements of loyalism, obedience and expressed the insulation of the scientist which formed part of the IACS's discourse. Arguing that if the scientists help the Government during War, the Government would certainly help IACS in the future he added, "

[104] *Ibid.* 1899, p. 17
[105] *Ibid.* 1898, p. 21.
[106] "On the Desirability...", pp. 8-9.
[107] *Annual Report*, 1898, p. 39.
[108] *Ibid.*, 1915, p. 26.

Gentlemen, I do not dabble with politics, nor have I a mind to do so. I am a Hindu of the Hindus and I know too well that if I behave well, my governor can never be harsh with me. We must not find fault with others, but must know what we are."[109]

The ethics of pure science, the insulated pursuit of knowledge and faith in the higher morals of science, shaped the attitude of Indian scientists towards British rule,

> Britannia expanded her empire all over the Seas but she came to India not with the idea of conquest but to meet her elder sister as it were. The younger sister, seeing the lawlessness and disorder, prevailing over the whole country of her elder sister, gave her law and order and the elder in return bedecked her with pearls and gold...[110]

The metaphor of the elder sister used here for India and the younger one for Europe is very interesting. Although Mahendralal had generally referred to Indians as 'children', the evidence of India's ancient civilization and the Orientalist glorification of the same paved the way for this comparison between India and Europe. The justification of the present state of India, in spite of such an illustrious heritage had occurred, predictably enough, because of 'lawlessness and disorder". Now, if the two metaphors used by Mahendralal and Amritalal are combined we get an interesting picture. The elder sister (India) in spite of her age and wisdom had lost her glory due to lawlessness and disorder. As a result, she could not guide her children to maturity, which her younger sister (Europe), with her more superior order and new knowledge was able to do.

However, the appreciation of a glorious ancient Indian civilisation made the task of introducing western science into this country more complicated for Sircar and his colleagues. How Sircar and IACS tried to grapple with this problem constitutes the final subject for discussion.

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[109] *Ibid.*,
[110] *Ibid.*,

Western Science and the Eastern Mind

Having defined Western science as essentially of European origin and pedigree, the problem Mahendra Lal faced was that of preaching it in a country so very different. The problem was of a great magnitude for to Sircar, as he believed in the existence of an Eastern mind and culture comprising of the Asiatic world.

Sircar was never actually interested in the past itself. Many of his historical remarks are thus sometimes inconsistent if not contradictory. He did not attempt to systematically develop an idea of an Indian past. His ideas were often directly based on the Orientalist classifications of the East and the West in which the Oriental man was essentialised in a manner which emphasised the differences between him and modern western man. If the distinctive culture of west was its science, its technology and love for progress with reason at its heart, the distinctive culture of East was its spirituality.

Sircar borrowed his idea of Indian antiquity from the Orientialist notion of the Indian past. He quoted an European Orientalist scholar to prove the point that India was the land of "all the wealth, power and beauty that nature can bestow".[111] The Indian mind had, "most fully developed some of its choicest gifts, has most deeply pondered on the greatest problems of life, and has found solution of some of them which well deserve the attention even of those who have studied Plato and Kant." The literature that it produced was concerned with the inner and eternal life.[112] Indians should take pride that they "own such a land as the land of their birth and who have the privilege of having come from such a glorious ancestry".[113] Sircar often referred to an "Aryan vigour', while talking of Indian regeneration by which he meant the dormant but not dead spirit of the Indian mind. Not very clearly formulated, this concept was used by Sircar to

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[111] *Ibid.*, 1899, p. 15.
[112] *Ibid.*, p.16

[113] *Ibid.*

argue that Indians were capable of pursuing scientific research.[114]

Mahendralal's distinction between the Eastern and the Western mind was located in his cosmology. It constituted of things material and spiritual, of the matter and the mind. The matter was the manifestation of the Supreme Mind with the impress of His image upon it and therefore capable of development from the lower to the higher forms through fixed and eternal laws.[115]

Thus science which, to Sircar was the enquiry into the laws of so-called matter was ultimately an enquiry into the thoughts of the Eternal mind. In Sircar's opinion the West and East had pursued two different trajectories of development. While the West pursued the study of the laws of matter, the East had only been involved with the mind. Eastern spirituality according to Sircar, had become meaningless without matter and 'reason'. Thus begins his critique of the East. The obsession with and the romanticisation and overvaluation of Eastern spirituality had suddenly given East a lamentable, backward appearance. In other words it was the opposite "back swing of the pendulum" referred to by Said.[116] This confinement to the spiritual was the crux of the decline of the East because, "To despise matter and to neglect the study of its laws is to despise ourselves and to neglect our own interests".[117] It is possible to see that Sircar's cosmology of mind and matter was influenced by Bacon's notion of the Divine Mind and the new scientific method of grasping the same.

Sircar, following the Orientalists, went on to produce a critique of the aggressive materialism of the west. In doing so Sircar comes close to his contemporary and the other prominent 19th century Bengali intellectual- Bankim. He too, like Bankim, stressed how Christianity had failed to counter material culture,

> The Civilization of the west, notwithstanding its profession of the blessed religions of love preached by Jesus Christ two thousand years

[114] *Ibid.*, 1896, p. 20.
[115] *Ibid.*, 1902, pp. 20-21.
[116] Said, *op. cit.*, p. 150.
[117] *Ibid.*, p. 22.

> ago, is still and threatening to become more and more the civilization of iron and blood, whose aim seems to be to polish the weaker nations and the so-called savage races off the face of the earth, forgetful or unmindful of a cardinal doctrine of that religion, that "of one blood hath God made all the nations of man".[118]

For Sircar, the solution was thus not in European Christianity which before this aggression, "seems to be absolutely impotent".[119] The answer was to be sought, according to Bankim, in the spirituality of the East. Bankim's synthesis was to produce a complete and perfect man- learned, wise, agile religious and refined- a better man than the merely efficient and prosperous being produced by the West.[120] Sircar, too, believed that the eastern spirituality could 'humanize' the West. "Even at the risk of raising the smile or even the laughter of contempt at the audacious declaration, I cannot help giving expression that that influence will proceed from India,...".[121]

Sircar believed that religion and spirituality could play an important role in science. Spirituality was not opposed to science; it was the crowning glory of man's rational pursuits, the ultimate sphere for man's search for the truth of nature or the Supreme Mind,

> I cannot believe that faith is blind and religion is irrational, that is, that they have no basis in the understanding as they have in the heart. What truly constitute man's higher and spiritual nature are, it must be

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[118] *Ibid.*, 1900, p. 25.
[119] *Ibid.*
[120] Chatterjee, *Nationalist Thought,* p. 67. However, in Bankim's case the reconstruction of the perfect man was perhaps not as straight forward as suggested by Chatterjee. Sudipto Kaviraj argues that Chatterjee exaggerates the Victorian elements in Bankim's *Krsna*-the perfect man. According to Kaviraj, Bankim reconstructed Krsna within a traditional framework of redefinition. In the Gaudiya Vaisnava tradition, Krsna was transformed from a warrior - rationalist figure to a man of action and serious philosopher of praxis. Bankim reconstructed Krsna from within that tradition to provide a rational (as different from 'rationalist) solution to the crisis of the colonial situation. Krsna through this 'rational' reconstruction was transformed into God of a dependent nation who had to help them cross, nullify, reject and transcend in practise the historic indignity, subjugation. This is part of Kaviraja's larger contention that Bankim was a man of both the traditional and the modern worlds. Bankim's aesthetic can to set against that of classical Sanskrit literature, and at the same time, that of the modern. See his *The Unhappy Consciousness; Bankimchandra Chattopadhyay and the Formation of Nationalist Discourse in India.*, Delhi OUP. 1995, particularly, pp. 74-106.
[121] *Ibid.*, 1900, p. 26.

> remembered, *super-addition to his animal and intellectual nature, which they were intended to crown, and not supersede.* They stand enthroned on their conjoint platform. And the more elevated the platform the sublimer must be the flight of that which stands by the platform.[122](emphasis mine)

India, Sircar believed could provide this 'sublime' spirituality to western materialistic science.

Sircar's thoughts were an interesting reflection of the ultimate romantic Orientalism of Bouvard, Schlegel and Novais. The latter believed that a study of Indian spirituality would defeat the materialism and mechanism of the West, leading to the regeneration of Europe.[123] Sircar's nationalism altered this vision slightly for Indian regeneration.

But which India could fulfil the imposing task of humanizing science? The present degraded, divided, immoral country? Bankim imagined an ideal India which had a strong, aggressive Hindu national culture and pride.[124] Mahendralal Sircar, the scientist, differed from Bankim on this point. To influence western civilization, the East must morally regenerate itself through western science and 'rational' culture. Both men were talking of a cultural assimilation, a national regeneration of the East and 'moral conquest' of the west, although their paths differed.

Sircar's concept of true religion varied from that of Bankim. Sircar's monotheism, his belief in the Almighty Father, differed from Bankim's trinity.[125] Along with it went his critique of the idolatrous priesthood and his active support to reform movements of Hindu social systems which reflected traditional 'unscientific customs'. He was a great advocate of the raising of the marriageable age of boys and girls in the Brahmo Marriage Act inaugurated by Kesab Sen and of the Age of Consent Bill.[126] He was a monotheist and his writings show his

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[122] Sarat Chandra Ghosh, *Life of Dr. Mahendralal Sircar,* P.C. Calcutta, 1935, p. 317.
[123] Said, *op. cit.*, p. 115.s
[124] Chatterjee, *Nationalist Thought* , pp. 56-57.
[125] *Ibid.*, p. 67.
[126] Bose, Chunilal, *op.cit.*, pp. 45-46.

reverence for the Creator, his faith in His Dispensation and a thorough resignation to His will. He denounced idolatry and saw 'God in Nature' and 'Nature in God'.[127]

It was with such faith towards monotheism and the Supreme Mind that Sircar sought to question Darwin's theory of natural Selection. And it was here that he found an ally in his life long partner- Father Lafont, the Jesuit Missionary who had urged Indians, not to "...attach undue importance to discoveries on the material side of the Universe".[128]

Father Lafont's (1837-1908) career has to be studied along side the history of St. Xavier's College (1860), an important institution of science education in 19th century Calcutta. Father H. Depelchen and seven other Jesuit Fathers founded St. Xavier College on 16th January 1860. The prospectus made it clear that lessons in science were to be imparted in a manner similar to that in Europe. Within fourteen years of its foundation, the college inducted several Jesuit fathers who were outstanding scientists: Eugene Lafont (1865) Edward Francotte (1869) and Alphonse de Penaranda (1874).[129]

Lafont was probably the most brilliant of them all. He received his training in science at Namur. As soon as he reached Calcutta, he started popularising and demonstrating elements of science and acquired apparatus for his laboratory. In St. Xaviers College, Lafont was primarily involved in meteorological studies and had an observatory built on the college terrace. He was soon well known for his accurate predictions of the cyclone of 1867. In 1874, he initiated investigation in spectro-telescopic studies and started astronomical studies, in which he was helped by Father Penaranda.[130]

In the early 1880s, Lafont saved the first ballooning experiment in India from the mouth of disaster. Percival Spencer, a ballooning expert, claimed was

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[127] *Ibid.*, p.46.
[128] *Annual Report*, 1907, p. 45.
[129] Biswas, *op. cit.*, pp. 77-78.
[130] *Ibid.*, pp. 80-84.

to hold a show in front of a huge crowd who had bought tickets for the event at Ballygunje *maidan*. The gas company involved failed to inflate the balloon, Spencer's attempt was unsuccessful and tickets were refunded. Lafont, never to lose out on a chance to demonstrate the wonders of science to an Indian crowd, volunteered to generate the hydrogen required if Spencer agreed. This was settled and a few days later another huge crowd assembled at the Race Course; the Grand Stand Course and *maidan* were packed. The Viceroy Lord Ripon was present and the balloon slowly rose helped by high southerly breeze to much joy.[131]

If Lafont indulged in flights of fancy, Sircar sought to ground his ideas in practical considerations. In Mahendralal's scheme of Eastern spirituality the Eastern mind was endowed with a high imagination which could give a new direction to scientific research. But he was careful to stress that an Oriental imagination, without 'rationality' had become meaningless. It had to be brought under the control of reason, so that it "may not run wild regardless of or in opposition to, positive facts".[132] Reason would be the string to tie the balloon of Indian imagination to the ground; imagination without reason had been the root of Indian misery.

> (How) the Asiatic mind can be developed to its full proportions, is by the cultivation of physical sciences, where the imagination may take its sublimest flights, but always as a captive balloon, though with an ever lengthening chain of positive facts, which, while it gives it ample scope to soar beyond the region of senses, keeps it bound down to the solid ground of truths already discovered.[133]

Thus on the one hand while Indians were taken on a fascinating ride into the world of scientific wonders, on the other, they were taught the virtues of scientific control, order and rationality. Western science was to take total control of Indian emotions and their intellect. This was how the project of, their 'regeneration' was supposed to take-off. Lafont and Sircar had some more goals

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[131] Udayan Namboodiry, *St. Xavier's; the making of a Calcutta Institution*, Viking, 1995, p. 69.
[132] *Annual Report*, 1900, p. 22.
[133] *Ibid.*, pp. 22-23.

in common, including developing the spirit of fundamental scientific research among Indian youth.

The Jesuit scholars of ST. Xavier's college, such as Lafont, were using the college laboratory to demonstrate scientific theories and experiments with the help of instruments. They also encouraged students to take part in such experiments. During the 1870s while a few pieces of scientific equipment languished in Presidency College, the St. Xaviers laboratory was vibrant with activity and was the "cynosure of all eyes".[134] Lafont wrote to his Superior in Belgium to send the college more priests with scientific learning. During his visits to the Paris Exhibitions (1879 and 1900), Lafont procured the latest equipment for his laboratory.[135] Moreover, under his leadership the Society of Jesus sought to develop a scientific culture not only in Calcutta, but through the metropolis, in other parts of the country.[136]

Father Lafont, like Sircar, was a crusader for fundamental research. His advocacy of greater stress on science, experimental science in particular, and more laboratories in colleges convinced the members of the 1903 Indian University Commission to develop more laboratories and museums.[137] To Lafont fundamental science had a great appeal because as a missionary, a teacher and a scientist in colonial India, he found in such science the true knowledge to enlighten Indians about the 'truths' of nature. Technical training could be helpful only after that, "It would be difficult to teach a nation how to apply things they do not know anything about. It is necessary, therefore, to teach the sciences before their application to the arts could be taught with advantage."[138]

Sircar could not have found a better supporter for his own project of enlightening Indian minds with the virtues of science. It is not surprising that Lafont was the first to respond positively to Sircar's 1869 article. Lafont

[134] Biswas, *op. cit., p. 86.*
[135] *Ibid.*
[136] *Ibid.*
[137] *Ibid.*
[138] *Ibid.*, p. 84.

subsequently assisted Sircar in establishing and developing the IACS. Significantly the Catholic priest considered this to be the best thing he did in India.[139]

But the most crucial area in which their ideas met were in their concepts of spirituality, religion, mind and matter. It met in Sircar's Monotheism and Lafont's Catholicism. Being a Catholic priest and a scientist was problematic, particularly when modern scientific theories were rejecting Christian theology. For Lafont, however, the study of scientific truths was the "study of God's works".[140] About being a Christian missionary he said, " I belong to a community commonly, though erroneously, regarded as antagonistic to science. Well gentlemen, I declare to you, though Catholic and a Priest, I hail with delight and pursue with love any advance of true science".[141] Lafont often asserted: "Truth cannot be opposed to truth."[142] Thus for him, the study of science was compatible with the spirituality of Christianity. To him science dealt with nature, it was a study of the laws which govern the natural phenomenon, was the study of God's work. It was for this reason, Lafont, like Sircar, believed that the study of science had a moralising influence on the human mind. "The more we study the works of God, the more are we convinced of the 'vastness', the 'glory' and the 'splendour' of the Mind which is often beyond our grasp."[143] Lafont recommended science as the ideal moralising and learning experience for 'regeneration' of the Indian 'mind', which was not true for "many other products of western civilization".[144]

> When I took upon myself the task of diffusing and popularising Science in Bengal and joined my efforts to those of Dr. Sircar, I was compelled by the thought that I could in all conscience recommend to the natives of this country, the unrestricted study of Western Science without misgivings or restrictions, because. I saw in it the study of God's works

[139] *Ibid.*
[140] *Annual Report,* 1904, p. 29.
[141] Namboodiry, *op. cit.,* p. 77.
[142] Biswas, *op. cit.,* p. 87.
[143] *Annual Report,* 1902, p. 32.
[144] *Ibid.,* 1904, p. 29.

and nothing but good can come out of it.[145]

For Lafont, such a study would ensure a higher morality and a new religious ethic among Indians which came tantalisingly close to Christianity. The moralising tone of this passage, reminds us that Lafont had come to India not just as a science teacher,

> In the study of the laws and facts of Nature, they (the natives of this country`) would find an incentive to the love of Nature's God, they would increase in reverence for the Creator, they would in fact become not only *clever* men, but *better* men, knowing their duties towards their Almighty Father and towards their fellow creatures,, in a word they would learn to become more useful and less selfish members of the Universal Brotherhood of mankind.[146] (emphasis mine)

But to be fair to Lafont, he was not the only person talking of a new religious ethic bordering on Christianity in 19th century India. Ram Mohan's monotheism shared many of aspects of Christian cosmology. In fact we have already seen how Sircar's monotheism shared some of the values of Lafont's spirituality and morality and urged that western science be infused with this new religious ethic. Both believed in taking the Indian mind to a higher morality and enlightenment with this combination of materialism and spirituality. The IACS had provided the ideal platform for this project. In an Orientalized India, Lafont found an ideal field to reactivate the 'ideal', of a 'lost' spirituality to counter materialist western science. And in the spirituality of science Sircar found the ideal justification for the study of science by Indians. Such was the common meeting ground for Lafont and Sircar. This is how Mahendralal sought to build a bridge between Western science and the Eastern mind.

For such a project, Sircar found Comte's positivism too materialist, as it sought to eliminate the concept of the Supreme Mind from science. He remarked that it was "a philosophy which had gone far beyond agnosticism, and audaciously taken up the position of an emphatic protest against all belief in a

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145 *Ibid.*
146 *Ibid.*

creative intelligence as opposed to all progress..."[147] Indian positivists, of course found Sircar's theological hypothesis regarding the origin and destination of the world incompatible with positive science. "A man cannot serve two masters; "they wrote," sooner a later, he, (Sircar) must make his election between theology and Positive sciences".[148] But Sircar was firm in his faith in the need to spiritualise science. To demonstrate his point he challenged Darwin's theory of natural selection, in which, he found support once more from his missionary friend.

In a famous lecture, called the "Moral Influences of Physical Science," he argued that the history of evolution had to take note of the concept of first cause.[149] Sircar showed that in the beginning even Darwin almost agreed to the existence of a Deity and a first cause, but later doubted ability of the human mind, which he believed had evolved from the lowest animals, to deal with such complex thought of its own origins. The implications of Darwin's arguments, that the mind of man would not to be trusted to come to any conclusions, were unacceptable to Sircar. For it would lead men to "suspend judgement in every matter and paralyse all action".[150] For Sircar the human mind was capable of drawing legitimate conclusions from sufficient data using the 'scientific' method. Such methods would establish the legitimacy of the first cause as it "satisfies the very necessity of our being, and offers the only solution of the great mystery by which we are surrounded".[151]

To the doctor it was not only the origin but also destination of life that was important. Death for him, was a blessed event which freed the inner spirit from the trammel of its existence in this world. A concept of never-ending life was crucial to Sircar's scheme for then, man could see a beneficial meaning in the Universe and could be assured of his destiny and his reverence for the

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[147] "Moral Influence", p. 30.
[148] "Dr. Sircar on Scientific Education", *The Bengalee,* 15th January 1870, pp.20-22.
[149] "Moral Influence", p.30.
[150] *Ibid.,* p. 22.
[151] *Ibid.,* p. 23.

Supreme Mind. For Sircar, science was the knowledge which sustained this grand faith of origin and destiny of life. A true knowledge of science would sustain faith in the Creator and not oppose it.[152]

If such was the nature of true science, Sircar argued, it had a great future in the land of spirituality-India. He suggested that the introduction of science to the Eastern Mind would not be disruptive or shatter its spirituality leaving behind a "bitter atheism and sad agnosticism" as often feared. It would actually enrich its spirituality.

> I do not believe that man's higher nature has suffered in the least from the advance of science. I do not believe that the noblest aspirations of man have received any check from the unfolding of what are falsely called 'cold material laws'.
>
> ....
>
> I do not believe that man's primitive faith and with it his religion, has anything to fear from what are ignorantly apprehended to be encroachments of science.[153]

Darwin's theory in late 19th century Europe, which argued for the abolition of teleological evolution was a highly disturbing theory. Both religious groups and biologists found it difficult to accept evolution just for competition for survival and without a specified goal.[154] Sircar's reaction reflected the contemporary European reaction to it.

It should be also mentioned here that Darwin's theory of evolution was widely contested in 19th century colonial India. Bankim's explanation of evolution rested on the concept of Hindu trinity: creator, preserver and destroyer (Brahma, Vishnu, Maheswara) as different from Darwin's scheme. His attempt was to show that the trinity was not in opposition to science.[155] The other important critique came from Ramendra Sundar Trivedi, at a slightly later period. Trivedi's ideas ran along similar lines to Sircar's, but he could not sustain

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[152] *Ibid.*, pp. 23-30.
[153] Ghosh *op. cit., p. 317.*
[154] Kuhn , "*The Structure of Scientific Revolution*, pp. 140-141.
[155] Chatterjee, *Nationalist Thought*, p. 67.

his absolute faith in science. He came to the conclusion that the evolution of the world ultimately was *maya*-controlled by supernatural forces beyond the comprehension of science.[156]

But Sircar and Lafont remained faithful to their particular definition of science, particularly its moral message for Indians. In his last communication to the IACS, before his death, Sircar wrote, "I have only to reiterate my conviction that if our country is to advance at all and take rank and share her responsibilities with the civilized nations of the world, it can only by means of science on positive knowledge of God's work..."[157]

Thus Sircar presents another instance of the negotiations between materialism and spirituality that marked Indian nationalism. Partha Chatterjee puts forward an argument to understand the resolution of this dichotomy, which he considers a "fundamental feature of anti-colonial nationalism in Asia and Africa".[158] According to him, anti-colonial nationalism created its own sphere of sovereignty within the colonial society where the 'material' is a domain of the 'outsider'. In this domain western superiority was acknowledged and its accomplishments had to be studied and replicated. The 'spiritual', on the other hand, was an 'inner" domain bearing the essential marks of a colonised society. It was essential as a part of the search for national identity to preserve this spirituality and to keep the West out of it.

Sircar's career, although confirming to Chatterjee's logic of Eastern spiritual essentialism, is problematic regarding the question of its sovereignty. Sircar stressed the peculiarity of Indian spirituality but in doing so he did not deny the West its spirituality either. His project was to revive that spirituality that was lost to western science. To that extent the East appeared to have been endowed with certain advantages as it was unlike the West yet to lose its spiritual self. For Sircar, the spiritual domain was neither exclusive nor private to the

[156] Kumar, *Science and the Raj*, p. 195.
[157] *Annual Report*, 1903, p. 2.
[158] Chatterjee, *Nation and Its Fragments* p. 6.

East. Sircar's spirituality shared.and acknowledged the visions of Christian cosmology. His association with Lafont and his rejection of positivism confirms this project of a joint vision. Moreover his discourse on Darwin showed that he was prepared to launch his debate at a public sphere with representatives of both the West and East. On the other hand, Sircar acknowledged at the public level the need to expunge the non-progressive elements from Hinduism to adjust its world view with the requirements of a rational world order. It was through these negotiations that Sircar hoped to revive a universal spirituality in both East and West.

Conclusion

Science for Sircar, was a moral force. The study of its material and the spiritual aspects would reveal the Supreme Mind to human beings. The West was way ahead in this pursuit as it had developed the material study of the same. What it now had to do was to engage with its spiritual side. The East on the other hand was in a worse situation. While it had failed to develop the material culture of science, it had even lost its true spirituality because of contemporary decadent Hinduism. The task for the IACS here was thus two fold-to inculcate materialistic research and at the same time orient it towards spiritual pursuits. And this the Indians had to perform themselves as only that would ensure that they became responsible, self-reliant individuals. This was the sum of Sircar's nationalism.

Mahendralal through his nationalism sought to redefine western science and attempted to introduce new values to its form in 19^{th} century India. It was significant as the earliest attempt to re-spiritualise science in colonial India, by an individual who retained his absolute faith in science. Sircar's first attempt was to re-instil the *sapientia* in the *scientia*. But what was the content of this redefinition of science? Was it able to initiate a rupture within its western counterpart? To begin with Sircar's definition of science was based on Baconian concepts. Ultimately, Sircar believed in an imperialist notion of science as the conquest of the natural world by man,. His nationalism was based on the dream that one day India would incorporate the entire earth within her knowledge system and sent explorers to four corners of the planet.

> No part of the world requiring exploration will be without explorers from India. Not a single phenomena can occur, either in the heavens above or in the earth below, which can be predicted before hand and the observation of which might be of scientific interest and importance which India will not send her scientific men to observe and record[159]

Clearly, Sircar was recasting the same imperialist explorationist ethics of western science in the 19th century.

But even his spirituality posed little fundamental threat to 19th century western science. His monotheism like Rammohan's, actually reflected the impacts of Christianity on Hinduism. For Sircar, contemporary Hinduism diverted the mind from God's work due to ritual and priesthood. The similarity of his thought to the ideas of Lafont illustrate the point. He shared Lafont's famous notion of "from Nature's god to the god of Nature". Moreover, both their ideas were mooted in Bacon's project of the realisation of the 'supreme mind'. No wonder Indians appeared childlike to him. It was such an orientation that made it difficult for Sircar's views to ultimately question western scientific ethics. Western science had discarded Bacon's notion of the supreme mind and internalised its imperialist connotations. His critique of Darwin posed nothing new to the West which had learnt to marginalise and differentiate between Christian cosmology and science. To that extent, the questions Sircar raised appeared archaic and obsolete to western science.

But it was for this complex mix of ideas that Sircar remains an important part of Indian nationalist discourse. Although one of the earliest Indian nationalist enthusiast of science and nationalism, Sircar does not fit into the modern Indian secular tradition, which Nandy calls "official secularism".[160] In fact Nandy's categorisation of public/private and secular/religious does not apply

[159] *Ibid.*, 1898, p. 24.
[160] See Nandy, "An anti-Secularist Manifesto", *Seminar*, October 1985, p.15.

to Sircar.[161] This is because Sircar had rejected the dichotomy between the secular and the religious and in doing so avoided the trap of the 'private' and 'public'. Sircar, therefore, could simultaneously establish the first Indian science association, remain a worshipper of rational values in his private and public life and yet find a friend in a missionary to critique Darwin in a public lecture or reject Comte's positivism. It were these elements that made his project particularly protean.

Finally, an interesting way to situate Sircar's spirituality would be by analysing his interaction with the mystic saint Ramkrishna. Sircar treated Ramkrishna for throat cancer towards the end of his life. The saint, an illiterate worshipper of Kali, who lived and preached in a mystic tantric world, exposed Sircar to complex tantric ideas. Dr. Sircar acted as a friend a companion and as a professional doctor. He would come to treat Ramkrishna, ask him a few questions, and then stay for hours to talk to the saint and argue with the devotees about their belief, about the merits of western science and physiology, and about the meaning of Ramkrishna's trance (*Samadhi*). But Sircar rejected Ramkrishna's tantric religion. For Sircar it represented decadent Hinduism, although he respected the Saint for his wit and wisdom. He stated that *bhava* and *samadhi* were manifestations of mental perversion. He took particular objection to the sanctification of Ramkrishna by his disciples. According to him, religion had to appeal to reason. Science and religion were the two strands of the same rationalist pursuit of understanding nature. One appealed to the material world and the other to the spiritual. Ramkrishna's religion was of course woven around the concept of love towards and worship of Kali the Goddess of *shakti*. To Ramkrishna and his followers, Sircar represented the western rationalist man, who had taken the attacks of the Christian missionaries on Hinduism seriously.[162] Ramkrishna's disciples believed that Sircar was a man who believed in God, but did not honour the scriptures, the Gods and Goddesses, or the strange powers that the

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[161] See, *Ibid.* and also his "The Politics of Secularism and the Recovery of Religious Tolerance" *Alternatives*, Vol. XII, 1980, pp.177-194.
[162] Jeffrey J. Kripal, *Kali's Child; The Mystical and the Erotic in the Life and Teachings of RamKrishna*, The University of Chicago Press, Chicago and London, 1995, pp. 253-255.

sages were said to posses. They thought that the doctor "could not understand such events" as he was "so influenced by western education."[163] Sircar remained a friend to them, but a critical non-believer. Within his rigid definition of Hindu spiritualism, men like Ramkrishna and his followers had become unacceptable.

[163] *Ibid.*, p. 256.

CHAPTER - 5

Researching for an Indian Science-1

The first nationalist scientific institution having been established, it was time for Indians to plunge deep into research. In the early half of the twentieth century a few Indian scientists emerged to prominence. This was also the time when the Indian national movement was expanding, with the Swadeshi movement in the first decade and the emergence of Gandhi in the second. Many scientists became actively involved in the political movements of the time. While the nature of this involvement differed from individual to individual, the careers of almost all the scientists of this period has to be analysed in terms of the dual commitment -towards science on the one hand and nationalism on the other.

These Indian scientists now expressed a new found confidence about the position they and their science enjoyed in Indian society. If Mahendralal Sircar had died a frustrated man due to the poor response he received from his countrymen, Prafulla Chandra Ray, almost thirty years later, exuded optimism: "A new era has evidently doomed upon India. Her sons have taken kindly to the zealous pursuits of different branches of science. May the torch thus kindled burn with greater brilliance from generation to generation!"[1]

One reason for this optimism was the greater legitimacy that science had earned within the nationalist discourse. The new generation of scientists like Jagadish Chandra Bose, P. C. Ray, P. N. Bose, P. N. Datta, had helped to established this legitimacy through their active participation in the nationalist discourse.

In the present chapter I focus on one of these individuals, the eminent physicist- plant physiologist-- J. C. Bose. I analyse his popular writings and speeches as well as scientific researches to show how he sought to redefine

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[1] Prafulla Chandra Ray, *Life and Experiences of a Bengal Chemist*, Chukerbertty, Chattajee & Co. Ltd., Calcutta, 1932, p.v.

science. Since they were nationalists their science is often called 'Nationalist science'. It would be my endeavour to analyse the content of this definition. How did his work combine 'science' and 'nationalism'? How did he view western science?

Bose was the first Indian scientist to receive recognition from Europe. His ideas resonate those of Sircar and Lafont. In his researches, he too sought to introduce eastern spirituality and monism within a 'materialist' western science.

The most important work on Bose has been written by Ashis Nandy.[2] He demonstrates with a detailed psychoanalysis of Bose's life and work how he almost succeeded and then failed to challenge the western denomination of science. Nandy analyses Bose from mainly three points. First was the Indian tradition of monism that shaped Bose's work. It made him assert that all elements of nature were arts of one living entity, that is life. Nandy identifies this monism as an Indian Vedic concern to impose order on the diversities, contradictions and oppositions within its fragmented, hierarchical society. Bose formalised this monism into a scientific idiom and research ideology. It not only made sense in his vitalistic research in plant physiology but also helped to generate culturally valid and personally meaningful symbols. His allegiance to this theory was this Brahmoism, with its concept of 'Cosmic Unity'. The monism offered a particular space for Bose among western audience: he could be seen as an outsider, gifted with an imagination capable of grasping the absolute yet simple truths of nature which had eluded European scientists.[3]

The second factor, analysed by Nandy was Bose's personal aggressiveness, which was due to his anxiety and low self-esteem. Nandy argues that within the greater Sanskritic culture, the various taboos on expression of instinctive and particularly aggressive impulse co-existed with a theory of creativity which conceptualises creation as the central to this destructive self of the Creator. Bose's reverence for divine power or *Shakti* of *Prakriti* or nature

[2] Nandy, *Alternative Sciences; Creativity and Authenticity in Two Indian Scientists*, Allied, New Delhi, 1980.
[3] *Ibid, pp. 58-66.*

mother was a worship of that special kind of power of creation. His study of oneness of nature was the manifestation of the inner violence and the latent power of nature.[4]

The third factor was the search among the nineteenth century Bengali *Bhadralok* for a semblance of self-esteem that could serve as the common core of intersecting personal, regional, and national identities. Bose, as a participant in this search, took upon himself the task of equipping the Bengali with a confidence about his own 'core' culture. For him the issue was not science, but nationalist science. His project was to legitimise his work in terms of tradition and then establish its credentials within western academia.[5]

The failure of Bose to ultimately bring about a clear transformation in western science's mechanistic world view was, according to Nandy, due to three factors. First, the promise and urge to prove Indian uniqueness proved too much of a load for him. Because of this commitment, his research lost the required flexibility.[6] Second Bose's increasing paternalism, which grew from his incapacity to handle professional criticism and an inability to admit that he was not autonomous as a scientist.[7] Third, the greatest problem was Bose's inability in his later days to keep his work open to criticism from his professional colleagues. That cut him off from the new directions that his conclusions were taking under others' research. Moreover due to his low self-esteem Bose eventually cut himself off even from his contemporaries and sympathisers in the national movement, people like Tagore and P. C. Ray.[8] That distanced him from both his science and nationalism and Bose's work was suffocated in this personal isolation.

Nandy's work is brilliant, and not intend to do. I tend to accept the major turn of his thesis. My problem is with his exclusive pre-occupation with psychoanalysis of Bose from his childhood. Although this is a valid way of

[4] *Ibid*, pp. 66-70.
[5] *Ibid*, pp.70-75.
[6] *Ibid.*, pp. 77-78
[7] *Ibid*, p. 78.
[8] *Ibid*, pp. 52-53.

analysing a person and his work, it tends to shift the focus from other aspects. The emphasis on psychoanalysis puts too much stress on the individual and ignores the fact that he was part of a complex grid of ideas that marked his times. Nandy thus tends to assign complete *autonomy* to Bose in choosing his symbols of Indian traditional thought and fusing them with western scientific ideas. I would like to show how his 'tradition', his 'Indianness' was also structured.

Nandy's concern is with Bose's personal failures, his insecurity and aggressiveness which ultimately curbed the larger possibilities of his work. Even while discussing the constraints of working within the rigid Indian 'uniqueness', Nandy states that it was actually Bose's self esteem and opressive - compulsive defences which did not allow him to make full use of his imaginative powers and the strengths of his culture.[9] This, I will argue is only part of the story. We need to look also at the larger context within which Bose's work was located and in the very roots from which it drew its sustenance.

Bose and his Early Work

J. C. Bose was born in Vikrampur in eastern Bengal in 1858, and grew up in Faridpur, a district headquarter near Dhaka. He started school at a small vernacular school at Faridpur, established by his father. His later studies were in western Bengal where his father was posted. At sixteen Jagadish passed from school to join St. Xavier's college, Calcutta.[10] Here, Father Lafont, by his fascinating experiments and demonstrations attracted young Jagadish to the physics laboratory. Bose who himself showed exceptional skills in handling tools and performing experiments found in Lafont an inspiring teacher. Lafont's clear exposition, experiments, opened up a new world to Bose.

In 1880 Bose left for his first visit to England to study science. In England he found an influential teacher in Lord Rayleigh.[11] Bose returned to India in 1884, to become an acting Professor of Physics, Presidency College,

[9] *Ibid*, p. 78.
[10] Patrick Geddes, *The Life* and *Work of Sir Jagadish C. Bose, Longmans, Green* and Co. London, 1920, pp. 1-23.
[11] *Ibid*, pp.30-31.

Calcutta. His appointment under the colonial government was certainly not smooth.[12] Till 1894, Bose did not engage in much research of his own. Research facilities were almost non- existent in Presidency College, and teaching absorbed much of his time. It was on his birthday in 1894, that encouraged by his wife, Bose vowed to resume his researches.[13]This marked the beginning of his first phase of research.

From 1894 to 99, Bose was involved in the production of the shortest possible electro-magnetic waves and the verification of its quasi-optical properties. It was with these researches that Bose earned his first acclaim as a scientist, particularly in Europe. His success was rapid. Within three months of his resolve he was able to devise and construct a new apparatus for his first research on electric radiation. Within a year, the Royal Society undertook the publication of his investigation, and offered a grant for the continuation of this research. The University of London conferred its D. SC., the Government of India, sent him to England for further researches.[14]

Before discussing the issue of recognition, it is important to understand Bose's work. This will help us identify the problematic within which his work was located.

For this we have to learn a bit about the history of the discovery of the Hertezian Waves on which Bose worked. The researches of Fresnel, Ampere and Maxwell had suggested the compatibilities between light and electric waves[15] Hertz discovered new waves of enormous scale- the shortest ones measured up to 4 yards and the longest 100s of yards.[16] Having discovered these waves the next step was to see whether they behaved like light waves. It was seen that they react to transparent, translucent and opaque bodies in the same manner that light waves do. These electric waves could also be reflected but not as precisely as light waves. They could be refracted with a prism as well. However Hertz died an

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[12] For details, see Kumar, *Science and the Raj* , pp. 218-220.
[13] Geddes, *op. cit.,* p. 39.
[14] *Ibid*, pp. 39-40.
[15] *Ibid*, pp. 47-51.
[16] *Ibid*, pp.51-53.

early death before he could develop his experiments further.[17]

When Bose entered the field the primary problem with electric waves was their largeness in size. Moreover, the uncertain behaviour and irregularity of discharge of the balls between which the oscillating discharge took place, made it difficult to separate good sparks from bad ones. On this latter problem Lodge and Bose made special developments. Lodge introduced an intermediate ball. Bose with his considerable experimental skill used platinum-covered surfaces, from and to which the alternating sparks could pass without roughening on oxidation. Bose's radiators were found to emit their sparks and their waves very steadily. By this Bose also reduced wastage and increased the energy of this radiation.[18]

However, Bose's actual achievement was in producing extremely short waves- which gave them a light-like characteristic and made them close to infra-red rays. Bose next started working on Hertz's receiver to make it more sensitive. Professor Branly of Catholic University College of Paris, and Lodge were also working on it. Bose's receiver was a development on both these two. He not only improved and perfected, but also condensed the enormous dimensions of Hertz's original devices. It could now be carried in a suitcase and demonstrated in any laboratory.[19]

Bose also carried on further investigation on the electric waves verifying the Laws of Reflection, the phenomenon of refraction, selective absorption by an electrically coloured medium, the phenomenon of interference, double refraction and polarisation. All of these were attempts to establish their similarities with light waves. Thus he showed that the short electric waves, which he produced, had the same properties as a beam of light, exhibiting reflection, refraction, even total reflection, double refraction, polarisation and rotation of the plane of polarisation. Apart from these discoveries, Bose's most important contribution in this field was the number of instruments he developed for these experiments.[20]

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[17] S. N. Bose, *Jagadish Chandra Bose*, National Book Trust, New Delhi, 1970, pp. 17-25.
[18] *Ibid.*
[19] Geddes, *op.cit.*, pp. 54-56.
[20] *Ibid*, pp. 57-58.

Thus the problematic of Bose's early researches were located within the field of electro-magnetic waves which had opened up great possibilities for physicists following the discoveries of Maxwell and Hertz. Bose was keen to improve on such discoveries. There was a touch of mysticism in his work, but there was nothing 'Eastern' about it. In the course of one of his demonstrations, Bose had pointed out the mystic, miraculous character of his discoveries. But if we read the passage carefully we would realise that this mysticism was a reflection of the nineteenth century fascination for science. It was the sense of miracle attached to the Victorian world view of science where science by unfolding the secrets of nature to human senses, indicated the vast darkness yet to be cleared. Talking of how higher and higher frequency of vibration took the waves beyond human perception, to a zone which was yet beyond human knowledge but gradually coming under the gaze of science he said, "How blind we are! How circumscribed is our knowledge! The little we can see is nothing compared to what actually is! But things which are dark now will one day be made clear. Knowledge grows little by little, slowly but surely."[21]

Bose's discoveries, part of which was done in England, was warmly received in the west although a group of scientists continued to be sceptical. Apart from England he travelled to France and Germany giving various lectures. He delivered the famous Friday Evening Discourse of the Royal Institution and his work came out in the Royal Society papers, *Electrician* and other technical journals as well the Liverpool meeting of the British Association.[22] Dr. Kunz an eminent physicist of Illinios University, appreciated his work, particularly the apparatus developed by him.[23] For many of them Bose's work was a revelation in another way. It exposed the absurdity of the prejudice that the eastern mind was incapable of scientific researches. Sir Henry Roscoe, The Vice chancellor of the University of London, acknowledged that the Eastern Mind was as capable in scientific researches, as the western one. Lord Reay, the former Governor of

[21] *Ibid*, p. 60.
[22] *Ibid*, p. 61.
[23] *Ibid*, p. 59.

Bombay remarked: "For science was absolutely international, and any result obtained by Dr. Bose in India could at once be annexed by us without protest".[24]

This certainly marked an important shift in the West's attitude towards the Other. During Orientalist times the West had realised that a wealth of information lay embedded in the natural environment of East. Now it was waking up to the fact that there was a wealth of talent as well. Did this mean the beginning of the end of the divide between the East and West- as far as science was concerned? Did the west come to realise that in doing scientific research the notion of Eastern and Western Mind was invalid? Perhaps not. The notion continued to exist, in a re-incarnated form. Although certain scientists had appreciated the scientific merit of his work, popularly particularly in the media, Bose was seen as the embodiment of a unique yet typically mystic Eastern Mind endowed with a capacity and a imagination to grasp the absolute and simple truths of this earth and the universe. That was how *London Spectator*, initially sceptical, finally came to terms with Bose: he was the "Bengalee of the purest descent",

> ...The people of the East have just the burning imagination which could extort a truth out of a mass of apparently disconnected facts; a habit of meditation without allowing the mind to dissipate itself, such as has belonged to the greatest mathematicians and engineers' and a power of persistence- it is something a little different from patience - such as hardly belong to any Europeans...Nothing would seem laborious to him in his enquiry, nothing significant, nothing painful, anymore than it would seem to the ***true sanyasi in the pursuit of his Divine.*** Just think what kind of addition to the mean of investing would be made by arrival within that sphere of enquiry of a thousand men with the *Sanyasi Mind*, the mind which utterly controls the body and can meditate and inquire endlessly while life remains, never for a moment losing sight of the object, never for a moment letting it to be obscured by any terrestrial temptation...[25](Emphasis mine).

Thus the East-West equation had been reversed without disturbing the prejudiced, essentialized characteristics of either. The same 'Eastern Mind' now appeared particularly suitable for science and actually it had some advantages over the western one. It was difficult to accept Bose just as a brilliant young

[24] *Ibid*, p. 65.
[25] *Ibid*, p. 66.

scientist. His 'Easternness' was emphasised, and he was termed a 'Sanyasi'.

Not just the media, even scientific community was eager to realise more meaning from his work. When Bose went to France, M. Cornu, President of the Academic des Sciences, presided over the meeting. In congratulating Bose, he spoke in a patronising and Orientalist tone: "You should try to revive the great tradition of your race, which bore aloft the torch-light of science and art and was the leader of civilization, two thousand years ago. We in France applaud you and wish you every success".[26]

Bose excited feelings not only in the West, but in India as well. At a time when Indian nationalism was trying to assert itself vis-à-vis the west, both culturally and politically, he was soon to be absorbed as a symbol of that assertion. Indian nationalism was trying to define an Indian form of education, religion and spirituality, which in turn was attempting to develop an Indian concept of nationalism and an Indian methodology of political action, a modern culture suitable for a nation.[27] We have seen how Sircar was highlighting the significance of this "Indianness". Bose appeared at this juncture of the ongoing dialogue within Indian nationalism between the 'traditional', the 'modern' and the 'national'. His success provided the vital nationalist link to science, hitherto associated mostly with West. Now even science could be nativised. Bose's achievement was expected to show not just his individual brilliance, but the greatness of 'Indianness' and Indian thought. His success was to become the success of national culture.

Bose's success in Europe had immediately turned him into a national hero in India. On 23 April 1897, when he and his wife returned, they were received by intellectuals and admirers like Ramananda Chatterjee, the editor of *Modern Review*, P. C. Ray and Dr. Nil Ratan Sarkar.[28] Ramananda Chatterjee, once Bose's student at Presidency College, played an important role in getting Bose closer to the Bengali middle class. As the editor of both *Modern Review* and

[26] *Acharya Jagadish Chandra Bose; Birth Centenary, 1858-1958,* Calcutta, Nov. 30, 1958, p. 14.
[27] Partha Chatterjee locates this trend in Bankim and shows that it is often erroneously termed 'conservatism' See Chattejee, *Nationalist Thought* , p. 80.
[28] *Ibid*, p. 29.

Prabasi he not only published several articles on the scientist but also pursueded Bose to write a number of popular science essays. Bose, in turn, introduced Ramananda to Nivedita who started contributing regularly to *Modern Review*.[29] The other individual who took important steps to popularise Bose's researches was Jagadananda Roy. Jagadananda had been one of the first teachers at Santiniketan and writer of scientific texts in simple Bengali, apart from a keen observer and recorder of minute natural phenomenon.[30] In a series of articles in the Bengali journal *Bharati* Jagadananda discussed in detail the intricacies of Bose's discoveries.[31] His efforts were prompted by the rising curiosity among Bose's Bengali admirers.[32] Jagadananda gave a detailed account of Bose's works on scientific Hertezian waves, the .instruments he developed and the theoretical context within which Bose's researches were located. In 1913, these writings were compiled into a book *Bigyancharya Jagadishchandrer Abishkar*.[33] His writings on Bose were charged with a great sense of nationalist pride. "The entire world is grateful to Bose for his researches, the humiliated Indian nation is obliged to him".[34] The immediate impacts of Bose's work on nationalism were two: it strengthened the moderate Congress demand for more science education in Indian schools and established that Indians could also do science. A month after Bose's arrival, *The Englishman* interviewed Bose and published a report on 22 May, 1897. Connecting Bose's work with the lack of science education it added, "given these (lack of science education) and given the mental bias produced by a long established scientific curriculum, the Indian mind would prove itself at least as capable of excelling in science as in literature and philosophy".[35] Jagadananda pointed out that although the works of Telang and

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[29] R. Chatterjee, "Hero as Scientist", *Modern Review*, 62(6), December, 1937, p.703.

[30] Pramathanath Bisi, *Rabindranath O Shantiniketan* (Bengali), Viswabharti Granthbibhag, Calcutta, 1402, (1351), pp. 113-115.

[31] Jagadananda's writings have been compiled by Arupratan Bhattacharya, in *Jagadananda Rachana-Samagraha*(Bengali),Ananda Publsihers,Calcutta,1985,for those on Bose see,pp.67-146.

[32] His first treatise began by mentioning that, "Many patriotic, science-loving gentlemen have complained, 'we have only heard that Prof. Bose has discovered something great, but we never got to know what it is all about. Till now they have not been disclosed in a serial form anywhere'", *Bharati*, (Bengali), Vol.24, Ashar, 1307, p.242.

[33] Atul Library, College Street, Calcutta.

[34] *Bharati*, 1307, vol.24, p.646.

[35] Vishapriya Mukherjee, *Jagadish Chandra Bose*, Publication Division, Ministry of Information and Broad casting, government of India, 1983, p. 29.

Rejendralal Mitra had received some acclaim in Europe in the fields of anthropology and textual studies, it was Jagadish Chandra who had single-handedly established the Indian fame in scientific research.[36] He added, "Jagadish Chandra by establishing himself at the metropolis of scientific research in Germany, France, England, America and by proving many of their conceptions wrong has not only honoured himself but has glorified the entire Indian nation".[37] Surendranath Tagore in 1901, explained why Bose's achivements were the only areas of true pride for Indians. The Vedic hinduism which too claimed such pride had over the years lost its glory. In the field of literature, in a short span of time Indians had shown great calibre but the appreciation of that by Europe raised such intricate debates that the true spirit of that literature have often been lost. Science, however, promised a lot more.

> The trajectories of science are different. Here even the unwilling can be forced to accept. Till now our enemies were telling us, "you are strong in useless imagination, experts in hollow speeches, but can you do anything in the field of observation, in the realms of science?" We had to accept such criticism. Firstly because, we really did not have anything to show here. Secondly, because, by accepting our inability we could get rid of the responsibility-avoïd the hard work.
>
> Anyway, today we have the pleasure to share this good news with our readers that --those days are over.[38]

Thus within an emerging consensus among the Indian intelligentsia regarding the superiority of scientific knowledge, Bose's success was endowed with special significance. It had let to new expectations and fresh responsibilities for the Indians in the arena of science, to emulate Bose. Surendranath reminded his readers the difficult course that Bose had to take because of lack of support. Recognition in the world of science was difficult and slow to come. Bose and the Indians thus had a long struggle ahead. While Bose was emersed in his researches, his countrymen had to become aware of his work, of science generally and thus provide him the right kind of support.[39] Thus Bose

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[36]Arupratan Bhattacharya, (ed) *op.cit.*, p.67.
[37] *Ibid.*
[38] "Bilate Professor Bose", *Bharati*, Ashar, 1308, p.319-320.
[39] *Ibid.*, pp.323-324.

had presented a strong case for Sircar's appeals for the cultivation of and the awareness in science. This is why he became crucial to the nationalist politics of the day. From this critical location, Bose was to play an important role in negotiating the cultural dilemmas of nationalism searching for a national identity.

I wish to suggest that between 1896-97 and 1900-01 there is a fundamental shift in the justificatory logic within which Bose's work was located. From the brilliant discoveries in the field of electro-magnetic waves, in this period, Bose's researches began to shift terrain, increasingly referring to larger nationalist as well as anti-materialist sentiments. To understand Bose and his work we have to study this period closely.

Let us see how in Bose's words, the concept of 'Indianness' gets redefined. His earlier works and speeches showed no trace or intention of identifying his research with Indian spirituality or monism. In 1897, when Bose was exposing his discoveries for the first time to the West, he did talk of his motherland but in terms that he was to renounce subsequently. While delivering his first Friday Evening discourse at the Royal Institution, 1897, he talked of an India which had to learn Science from the west and contribute to it. This India was devoid of spiritual greatness or any peculiar 'Indianness' in science. This India had to follow the leadership of the West:

> The land from which I come did at one time strain to extend human knowledge, but that was many centuries ago; a Dark Age has since supervened. It is now the privilege of the west to lead in this work. I should fair hope, and I am sure I am echoing your sentiments that a time may come when the east, too, will take part in this glorious undertaking; and that at no distant time it shall neither be West nor the East, but both the east and the West, that will work together, each taking her share in extending the boundaries of knowledge, and bringing out the manifold blessings that follow in its train.[40]

But such a vision was destined to change very soon and 'India' was to play a greater role in his science. Soon after Bose returned from Europe, Tagore called on him at his residence. Not finding the scientist at home, the poet left a

[40] Mukherjee, *op. cit.* p. 28.

magnolia flower on his table.[41] A couple of months later Tagore wrote a poem for Bose, which was published in *Kalpana*:

From the Temple of Science in the west,
    far across the Indus,
Oh, my friend, you have brought
    the garland of victory,
decorated the humbled head
    of the poor Mother
    ...
Today, the mother has sent blessings
    in words of tears,
    of this unknown poet.
Amidst the great Scholars
    of the West, brother,
these words will reach only
    your ears.[42]

Thus from early in his career to Indian nationalists Bose was not just a scientist. The nationalist discourse expected him to play a greater role and take up larger responsibilities.

In the International Congress of Physicist (1900) at Paris, where Bose presented a paper, Vivekananda happened to be present.[43] The monk, who had earlier preached the superiority of Indian (particularly Vedic) spiritual thought, saw Bose as the embodiment of a new India,

> Here in Paris have assembled the great of every land, each to proclaim the glory of his country. Savants will be acclaimed here; and its reverberation will glorify their countries. Among these peerless men gathered from all parts of the world, where is thy representative, O thou the country of my birth ? Out of this vast assembly a young man stood

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[41] Manoranjan Gupta, *Jagadish Chandra Bose; A Biography* Bhavan's Book University, Bharatiya Vidya Bhavan, Bombay, 1964, p. 68.
[42] *Kalpana* in *Rabindra Rachanabali* (in Bengali) Vol. 7, Viswabharati, 1975,p. 157, translation by me.
[43] Appendix III (B)., Gupta, *op.cit.*, p. 131.

> for thee, one of thy heroic sons, whose words have electrified the audience, and will thrill all his countrymen. Blessed be this heroic son; and blessed be his devoted and peerless help-mate who stands by him always.[44]

From a physicist, Bose had become the symbol of Indian national culture, its national pride. Tagore hoped that through scientific researches, "...may our India, our ancient land, unto herself return; once again return to steadfast work, to duty and devotion, to her trance of earnest meditation".[45]

What is significant in Tagore's words is the concept of "return". Science was no longer alien to Indian culture, India did not have to learn it entirely from West. There was a scientific essence within India itself. Doing scientific research in modern terms, was a way of going back to that essence, of realising the Indian scientific spirit. Thus the equations were changed. Indians now claimed scientific spirit as their own, and saw Bose's work as a manifestation of that. Bose's friendship with Tagore holds an important clue to the evolution of this idea. After the magnolia flower and the poem, their friendship did not take long to flourish. Soon the poet and the scientist were taking long voyages on the river Padma discussing their work and their beliefs.[46]An outcome of these talks was the idea that their pursuits were basically the same, only in different spheres. We will analyse their relationship- in fuller detail later. Such an analysis will also be linked with the larger thematic within which Bose's work was consistently being located both within Indian nationalism as well as to his western audience. However, the actual process of the formation of this identity for Bose and his work was more complex. This transformation was not a one way process- from his audience and then imposed on him to which he had succumbed. Bose himself had contributed to it perhaps unwittingly, in the beginning by the interesting direction that his researches took. For that we have to study how Bose's work shifted from physics to plant physiology. This would also demonstrate how he

[44] *The Complete Works of Swami Vivekananda,* Mayavati Memorial Edition, Advaita Ashrama, Calcutta , 1962, Vol. VII , pp. 379-380.
[45] This was a poem written by Tagore to Bose in a letter, see Geddes, *op. cit.*, p. 92.
[46] Gupta, *op. cit.*, p. 69.

became a champion to a third section of appreciators; the western romantics. Europeans, dis-illusioned by the materialist west who sought solace in the spiritual East .

Bose and the Electric Touch

Jagadish Bose, while working with his electric wave receiver came across some strange facts. After a couple of hours of experimentation, the receiver became less sensitive and after a while reminded one of fatigue. After a rest for several hours it became sensitive again. But keeping it aside for several days would make it insensitive which could not be corrected with further rest. That insensitive receiver could, however, be reissued by electric shock. So he came to the conclusions that a fatigued receiver could be revived by rest and an idle one could be stimulated by electric shock. Bose sought to explain this in terms of Electric *touch* or contact sensitiveness of metals, non-metals and metalloids obtainable. He realised that electric contact left stains over metals in varying degree.[47]

Having made this interesting discovery, Bose sought to test it in terms of his earlier work, that of composing electric waves with light waves. He composed the phenomenon of photographic stain over a photographic plate with that of electric stains. He observed that even photographic plates recovered from stain after some time. His next step (1901) was to conduct interesting experiments to prove that there could be photography without light , with electricity.[48]

Inspired by these interesting findings Bose was getting involved with the questions of responses to electric touch on various objects. With his receiver he had already found out that metals were highly sensitive to electricity and it left a stain on them. He thus started testing the sensitivity of various objects to electric touch.[49] Bose had already read his paper on the phenomena of the fatigues exhibited by his receivers of electro-magnetic waves and how they could be

[47] Geddes, *op. cit.*, p. 71-72; S. N. Bose *óp. cit.*, p. 26-27.
[48] Geddes, *op. cit.* p. 82.
[49] *Ibid.*, p. 84.

revived by shock and rest, at the Paris International Congress(1900). Here for the first time he compared this metallic fatigue and excitation with that of excitation of living tissues.[50] From now on he became involved with drawing parallels between the living and the non-living in their responses to electric stimulus. This is how he started working on his first and seminal book-*Responses in the Living and Nonliving* (1902).[51] Certain important observation have to be made at this point. Bose had become involved in the field of electric responses almost by accident. In the beginning it was clearly incidental to his actual work on waves, but the intriguing results gradually drew his full attention. Moreover, now Bose had stepped onto a relatively unknown field and was working at the frontier areas of electric responses.

The exciting responses that he observed from the inert, non-living bodies made him question the demarcation between the living and the non-living. He thus remarked at the Paris Congress: "It is difficult to draw a line and say, 'here the physical phenomenon ends and the physiological begins' or 'that is a phenomenon of dead matter, and this is a vital phenomenon peculiar to the living'".[52]

Along with this Bose's own ideas of the living and the non-living were undergoing transformation. Although Bose had been even earlier sensitive towards the inaminate, silent world of the plants, his ideas of the living and the non-living were rather conventional. In 1895 in an article in the Bengali magazine *Mukul* he had written about the hidden world of plants. He found 'life' in the tree, but not in the dry branch.

> Under the tree a dry branch is lying. Once this branch was full of leaves, now all that have dried up, the branch is infested with termites. A few days, later not a single trace of it would be left. Now, tell me, what is the difference between this tree and this dead branch? The tree is growing, while the branch is decaying; one has life, while the other has not.[53]

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[50] *Ibid.*, p. 88-89.
[51] J. C. Bose, *Responses in the Living and Non-Living*, Longmans, Green and Co; 1902.
[52] Geddes, *op. cit.*, p. 90.
[53] Bose, *Abyakto* (Bengali), Acharya Jagadis Chandra Bose Birth Centenary Celebration Committee, Calcutta, 1958, pp.20-21.

His later discoveries disproved this distinction. The tree, the dead branch, the rocks, all transcended the boundaries of the living and the non-living.

Bose was now performing his fascinating experiments of poisoning plants as well as metals like tin , zinc, brass and even platinum. The curves of responses of metals were found to be similar to those of plants and animals.[54] Next he tried to find out whether ordinary plants, those usually regarded as insensitive, exhibit the characteristic electric response already shown in 'sensitive plants'. In his Friday Evening Discourse before the Royal Institution (1901), Bose was able to show that every plant, and each organ of every plant was excitable and responded to stimulus.[55] These findings were ultimately combined in *Responses*.

His conclusion here challenged the idea among physiologists that response-curves were the result of various external agencies on the phenomenon of life; an unknowable arbitrary vital force, "but by working laws that know no change acting equally and uniformly throughout the organic and inorganic worlds".[56] So he proposed a new and substantial unification of phenomenon previously supposed to be strictly confined to animal physiology, and an extension of them first to the field of vegetable physiology and then to that of physics. Bose rejected the vitalist proposition that plants and animals were alive because of a 'vital' force within them. He proposed that what we identify as life was basically responses to an external energy which pervaded the universe and manifested itself in terms of light, electricity, temperature etc. Thus by demonstrating that even the inert, non-living bodies responded to such stimuli he challenged the very distinction between living and non-living. The traditional scheme of 'living' included the animal and plant kingdoms while the inert were categorized as 'non-living'. Bose's scheme transcended this distinction and united the three; animals, plants and inert objects into one, but only as different manifestations of the all pervading energy. To Bose the 'living' appeared to be

[54] Geddes, *op.cit.*, p. 94-97.
[55] See Bose, *The Nervous Mechanism of Plants,* Longmans, Gree and Co., Ltd., 1926, New York, p. VII.
[56] Bose, *Responses*, pp. 190-191.

so because of the more complex structure of their physiology which could be excited much more easily by external stimuli.

Bose now developed his major theory, which was to become his life long passion -the Unity of Life-a pervading unity that bears within it all things, "the mote that quivers in ripples at light, the life upon the earth, and the radiant sun that shines above us.."[57]

It is interesting to note that although Bose's conclusions were fall-outs of his involvement with electro-magnetic waves and stains, this unification of life fitted well with the emerging intellectual concerns of Indian nationalism. Monism was increasingly being identified as the essence of classical 'Indian' thought.

Bose and Monism

The nationalist search in the late nineteenth and early twentieth century for the essence of 'Indianness' found an answer in Vedic monism. As already shown in my last chapter, this often represented for Indians the essence of Indian spirituality. Given the confusing diversity and divisions that Indians were faced with, Monism provided an essential link to all these diversities. It promised them the much needed sense of unity and strength. Thus classical Indian literature tended to be read in terms of a monistic 'Indian' knowledge.[58]

It is because of this that Rammohun holds such a key position in the history of intellectual nationalism under colonialism. He was often seen as the person who rediscovered and identified of this essential monism within classical Indian thought. Rabindranath Tagore expressed this sentiment in his presidential address at Roy's birth centenary. In this speech we see the poet linking up the Indian past, Rammohun, Indian nationalism and the concept of monism,

> ...From the early dawn of our history it has been India's privilege and also its problem, as a host, to harmonise the diverse elements of

[57] Geddes, *op. cit.*, p. 98.

[58] Vivekanda for example saw in the Vedic tests the true Indian spirit the One Atma- See Tapan Ray Chaudhuri, *Three Views of Europe Nineteenth Century Bengal* CSSS, K. P. Bagchi, 1987, pp. 38-39 Monism and Monotheism was evident in the activities of Rammohan Ray , Sircar and others.

> humanity which have inevitably been brought to our midst, to synthesise contrasting cultures in the light of a comprehensive ideal.... Now that our outworn social usages are yielding rapidly to the stress of an urgent call of unity, when rigid enclosures of caste and creed can be more abstract the freedom of our fellowship, when India's spiritual need of faith and concord between her different peoples has become imperative and seems to have aroused a new stir of consciousness throughout the land, we must not forget that this emancipation of our manhood has been made possible by the indomitable personality of the great unifier, Rammohun Ray. He paved the path for this reassertion of India's inmost truth of being, her belief in the equality of man in the love of the Supreme Person, who ever dwells in the hearts of all men and unites us in the bond of welfare.[59]

However, this essentialist monism of the nationalists drew its inspiration from 18th century European historicism as well. As Said illustrates, Vico, Herder and Herman, all believed that all cultures were organically and internally coherent, bound together by a spirit, genius, *Klima* , a national idea.[60] For the Orientalists this concept of the coherence was certainly useful to 'understand' and 'capture' and to incorporate the elements from cultures other than the European.[61] It also led to a fascination with the Orientality of the Orient, the Indianness of India. That was how the Orientalists had started their search for coherence within Indian classical literature. This explains their obsession with 'pure' knowledge and classical texts. Indian intellectuals from the late nineteenth century, looked at these texts and found the monist concepts of the *Vedas* expressing a quintessential 'Indianness'.

This monism became part of the discourse of scientists searching for an Indian science. Many intellectuals drew parallels between Vedantic monism and science. As Gooroodass Bannerjee, a member of IACS argued,

> For every investigation there must be a specialist. Still we must not lose sight of the unity of science, and the unity of all universal phenomenon emanating from one Great Cause. The prophetic vision of the Rishis of yore has given us Vedantic monism in our philosophy. Science is

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59 "Address of Tagore as President of the Preliminary meeting of the Rammohan Ray Centenary, Senate House, 18th February, 1933, Calcutta", Satish Chandra Chakraborty (ed) *The Father of Modern India*, Rammohan Ray Centenary Committee, Calcutta, 1935, Part II, pp. 3-4.

60 Said, *op. cit.*, p. 118..

61 *Ibid.*

> seeking to illuminate the truth more clearly. Duality is being replaced by unity.[62]

He then solved two loop puzzles with sticks and showed that if there were any obstacle, the loop fastened fast. When there was no obstacle, the loop vanished. He thus proposed that man hankered after communion with the Universal Soul. The meeting together of the individual soul and the universal soul was the real *Mukti*.[63] Bose along with his contemporaries envisioned this Indian unity. In an essay in 1894, he identified the core, the heart of India in the Himalayas.[64] Bose too had seen in Rammohun's works the discovery of the essential monistic, spiritual thought of India.[65] His growing friendship with Tagore drew him closer to this monisim. Due to his strong Bramho roots Tagore had been initiated to the monism of the Vedas very early in his life. To him the diverse living world was a single entity, the nature reflected unity of life. As he put it - "I was made familiar from my boyhood with the *Upanishads* which in its primitive intuition, proclaim that whatever there is in this world vibrates with life, the life that is one in the infinite."[66] In scientific researches of Bose Tagore expected the scientific verification this idea: "This (Upanishadic Unity of Life) might have been the reason of the eager enthusiasm with which I expected that the idea of the boundless community of life in the world was on the verge of a final sanction from the logic of scientific verification."[67]

Thus the poet wanted to see the reflection of his own monistic cosmology in Bose's scientific work. Bose's work then could truly satisfy the cultural requirements of Indian nationalism.[68]

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[62] *Annual Report*, 1914, pp. 36.
[63] *Ibid.*, p.37.
[64] *Abyakto*, pp. 73-81.
[65] Bose, "Rammohan and the Unity of All Truth", Satis Chandra Chakrabarty (ed) *op. cit.*, Part II, p. 300.
[66] "Jagadish Chandra Bose memorial Address by Rabindranath Tagore at the Bose Institute on Nov.30, 1938", *Bose Birth Centenary*, p.68.
[67] Tagore expressed this at the Bose Memorial Address in 1938, *Ibid*
[68] This also explains Tagore's keen interest in Bose's scientific work. He was the first to write in Bengali, for a periodical he then edited, an account of Bose's lecture before the Royal Institution in 1901 on the response of inorganic matter to mechanical and electrical stimuli. The message that went out was the confirmation of the utterances of the *Upanishad* of an all –prevailing unity finding together all things.*Ibid.*, p. 48.

In 1931, on the occasion of Tagore's 70th birthday, Bose pointed out how the poet had influenced his ideas and his work, opening before him a wider view of life: "His friendship has been unfailing through years of my ceaseless efforts during which I gained step by step- a wider and more sympathetic view of continuity of life and its diverse manifestations...."[69]

His scientific research after this became the manifestation of these ideas:

> It was following this quest that I succeeded in making the dumb plant the most eloquent chronicler of its inner life and experiences by making its own history ... The barriers which seemed to separate kindred phenomena was found to have vanished, the plant and the animal appearing as a multiform unity in a single ocean of being ...The same cosmic unity has unfolded to Tagore's poetic vision and has found expression in his philosophic out look and in his in comparable poems...[70]

Thus the poet and the scientist had become allies in the pursuit of the same idea. Tagore expressed this partnership in his dedication of his *Katha O Kahini* to Bose, "You gave the jewels of Truth, I give you in return its words and visions."[71] It should be pointed out here that Bose's earlier monism, at the time when he sought the source of Bhagirathi, did not necessitate the challenging of the conventional distinction between the living and the non-living. But his discoveries that electric responses in both living and non-living were similar opened his mind to monism. Conversely, this monism promised a greater conceptual acceptance of his new discoveries. He could now play the role of a specific typecast 'Indian' scientist: one which Europeans as well as nationalists expected him to play. Accidental discoveries regarding the response of the living and the non-living, could now be ascribed to the unique and peculiarly 'meditative' Eastern Mind. Interestingly, the phenomena of metal fatigue, was not unknown in middle nineteenth century Europe,[72] but it did not have the same political and cultural connotations. In 1900, Bose had already written to Tagore

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[69] Bose, "A Homage to Rabindrnath Tagore", *J. C. Bose Speaks* (eds),Dibakar Sen, Ajoy Kumar Chakraborty, Puthipatra, Calcutta, 1986, p. 52.

[70] *Ibid.*,

[71] Tagore, *Katha O Kahini*, in *Rabindra Rachanabali*, Vol. 7.

[72] S.Timoshenko, *History of Strength of Materials*, Dover Publications, New York, 1983 (1953), pp.162-177.

mentioning his discoveries of metal reactions, suggesting that boundaries between the living and the non-living were becoming unclear and that through these researches the poetic and scientific visions could now merge.[73]

Bose's travels across India deepened this sense of 'Indianness' and Indian unity.[74] Immediately after his marriage, he and his wife began to devote the two annual vacations and knowing India. They travelled largely to the sites of ancient Indian glory, the old centres and shrines—Ashoka's stupas, the Narmada Valley, Agra, Delhi, Rawalpindi, Nainital-Pindari Glaciers, Kashmir, Konarak, Ajanta, Ellora, the ancient Buddhist temples of Ceylon, Taxila, Nalanda, Badrtinath-Kedarnath.[75] Recollecting his travels Bose remarked, "With all these experiences, India has made me and kept me as her son. I feel her life and unity deep below all."[76]

In his paper at the Royal Institution Friday Discourse in May 1901, Bose had already acquired a different and larger thematic significance for his work. From now on his researches were always the manifestation of classical India. He concluded the paper by saying,

> It was when I came upon the mute witness of these self-made records, and perceived in them one phase of a pervading unity, that bears within it all things- the mote that quivers in ripples of light, the teeming life upon the earth, and the radiant sun that shines above us – it was then that I understood for the first time a little of that message proclaimed by my ancestors on the banks of the Ganges thirty centuries ago – 'They who see but one in all changing manifoldness of this universe, unto them belongs the Eternal truth – to none else, unto none else !'[77]

[73] Letter from Bose to Tagore, March 16, 1900, see D. Sen. (ed), *Letters to Rabindranath*, The Bose Institute, Calcutta, 1994, p.18.
[74] Geddes, *op. cit.*, pp.108-119.
[75] *Ibid.*, p112-115.
[76] *Ibid.*, p. 115.
[77] *Ibid.* pp. 97-98. But it is important to note an interesting fact about this wisdom of ancient Indian monism Bose, had he intended; could have also reflected the same wisdom of unity of Life in ancient Greece as well. From 3rd Century A. D., with the rise of Neoplatonism came the full exposition of the metaphysical significance of the order of nature in relation to both the transcendent in the works of Plotinus, the founder of Neoplatonism, Natural Universe was seen as an organic whole with sympathy between its parts and possessing Divine Presence that we could detect by virtue of the presence of the Divine within us. All parts of the visible Universe acted reciprocally upon each other as a consequence of being part of one living All and being found by sympathy for each other. See Nasr, *Order of Nature*, pp. 91-92.

Here we find the fullest articulation of the nationalist, Vedic monism in his work. The boundary between the 'outer' and the 'inner' was transcended. The external omnipotent energy entered the body manifesting itself as the inner strength, as the 'self', and even resisting the external world. "What is mine amongst all this?" Bose asked. The answer he found in the notion of eternal energy: "The struggle between the inner and the outer has menifested life in its various forms. At the root of both is that Great power, which stimulates the living, the non-living, the molecules and the entire universe. Life is an expression of that Power."[78] His words conformed to those of Vivekananda, "All forces of Nature, therefore, must be created by the Universal Mind. And we, as little bits of minds, (are) taking out that Prana from nature, working it out again in our own nature, moving our bodies and manufacturing our thought".[79]

Bose's conceptions were not alien to Western audience either. Scientists in Europe had begun translating the Vedic terms into modern scientific concepts of 'energy' to establish the compatibility between the two. A contemporary physicist and admirer of Vedic texts, Professor Tunzelmann had urged :

> Although the Vedic scheme of the universe does not and could not be expected to bear detailed comparison with that of modern physical science, the similarity of their broad lines is extremely remarkable, even at first sight. It becomes still more so when we first take note of the fact that the term force corresponds far more with the modern concepts of energy than with that of force, and when the term energy is substituted for force, the Vedic scheme of development became identical with one which expresses the most recent development of physical research.[80]

Bose's work was now perfectly meaningful to the European scientific community, to the Indian nationalists and also to himself. Years before, when Bose asked the Bhagirathi river about its source, the river had replied, "From the hair of the Mahadeva (Siva)". And where did it end? The answer was "at the feet of the Mahadeva."[81] Bose's Friday Discourse speech was received well in the

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[78] *Abyakto*, p.198.
[79] *The Complete Works of Swami Vivekananda*, vol. I, p.506. for similar views see pp.8, 432-435, 356 of the same volume.
[80] *Prabasi*, Magh, 1332, vol.2, p.516.
[81] *Abyakto*, pp.73-74.

west. His last few words about Indian glory particularly had a strong impact. A scholarly British lady present there, wrote to Tagore,

> I fail to express what a thrill I felt, when the traditional Indian message of a grand cosmic unity was restated today in the language of modern times...His individual self seemed to disappear, and his nation emerged before our eyes. ...We realized that at long last India established the excellence of her wisdom before an assembly of western scientists, and emerged as the preceptor and not as a disciple, nor even as an equal.[82]

Thus the equations were truly reversed. It was the East, which was preaching the essence of science to the West. The categories of East and West strengthened themselves in a new equation. After the lecture, Sir William Crookes, a leading British scientist went upto Bose and requested, "Please don't forget to include the concluding quotations when the Royal Institution publishes your discourse. I have scarcely heard anything so grand".[83] Bose's scientific researches had now become secondary to the larger thematic within which he increasingly sought to locate his work. Tagore found in his work the true meaning of the universe which Indian saints had discovered so long ago.[84] Surendranath wrote in *Bharati* soon after Bose had delivered the lecture,

> He (Bose) has gone (to Europe) not to take lessons at the feet of the European scholars. He has not even gone to discuss certain things in equal terms. He has gone as a teacher to teach the lessons of a new truth. He has already delivered his first lecture at the Royal Institute which has made the best European scientists to humbly learn from him, some out of sheer reverence, others forced by his logic.[85]

Subhas Chandra Bose commented, "Your research has provided direct empirical proof of the unity which the ancient sages of India had found in the varieties of life..."[86] In 1906, *Prabasi* described Bose's work as the greatest work of *swadeshi*[87] Bose had become the symbol of a cultural revival of the East. Taraknath Das saw him as the leading figure of the 'Asiatic Renaissance', "The

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[82] Mukherjee (Visvapriya) *op. cit.*, p. 39.
[83] *Ibid.*, p. 42.
[84] Nandy, *Alternative Science*, p. 65.
[85] "Bilate Professor Bose", p.320.
[86] Nandy, *Alternative Sciences*, p. 65.
[87] Viswanthan, *Organizing for Science*, p. 29.

twentieth century is the era of Asiatic renaissance and various political and military leaders of the New Orient have captured the imagination and admiration of the world.... In the history of the cultural revival of Asia, Sir Jagadis Chandra Bose will, among others have a most prominent place."[88]

We can now grasp the process of Bose's transformation from a physicist in 1896- 97 to a plant physiologist, and then to an 'Indian' scientist in the 1900s. To his admirers this transformation was logical and necessary: he was in fact playing the role he was destined to play. In Nivedita's letter to Tagore, she described how by 1900 Bose had placed his earlier scattered work on its 'correct' philosophical footing,

> ...the work of 94 to 1900 had consisted of some dozen or more separate investigations on invisible light – polarisation.... It was apparently in the year 1900, however, that all these separate lakes began to combine in a series of generalisations which have not yet been given to the world in their completeness, and which are to prove of wider and wider philosophical interest as time goes on.... [89]

Bose was now inspired to give particular Sanskrit names to the instruments he developed, to resymbolise western concepts, bridging the modern West with the ancient East. The instrument for recording the contractile response of the plant was christened *Kunchangraph* (Kunchan = contraction), the appliance used for measuring sectional response was named *Shasungraph* (Shashun = suction).[90] However, it was his *Responses,* which epitomised the linking of nationalism and science. This book marked an important shift in the nature of Bose's publications, being the first in a series of similar publications. Instead of scientific papers for technical journals and institutes, he now explained in easily understandable language and various experiments, the nature of response in the living and the non-living. Geddes explains this shift from the traditional technical papers to books as an outcome of Bose's painful experiences with Royal Society where his papers were relegated to the archives.[91] The other

[88] *Modern Review*, 44(5), Nov. 1928, p.560.
[89] Appendix II (B), Full text of Sister Nivedita's letter, Gupta, *op. cit.*, p. 127.
[90] Kumar, *Science and the Raj*, p. 212.
[91] Geddes, *op. cit.*, pp. `122-123.

reason could be that Bose from now on was to address his works to a larger audience than the scientific community of Europe. His books reflected the nationalist agenda and were addressed to the nation. The dedication to *Responses* read: "To my Country men. This work is Dedicated".[92] Bose initially wanted a grander dedication, "To my countrymen who will yet claim, the intellectual heritage of their ancestors", but kept it short because he was "ashamed to write this explicitly".[93] A later volume, *Nervous Mechanism of Plants* was dedicated to "My life long friend, Rabindra Nath Tagore".[94]

The *Response* stated its agenda emphatically, beginning with a verse from *Rig Veda,* "The real is one: Wise men call it variously".[95] This book, of course, as Nandy shows, was strongly influenced by Sister Nivedita (Margaret Noble), the follower of Vivekananda, whom Bose had met in 1898.[96] Inspired by Vivekananda's speeches on the greatness of Vedic, Eastern spirituality, Nivedita was searching for évidence of Indian greatness. Bose's work appear to be the true reflection of that ancient unity of life. But Nivedita, a woman from the west, represented a third group that appreciated and shaped Bose's work-- the romantics. It is among this group that Bose found a few of his life long friends, who influenced his work and thought.

Bose and the Romantics

Historically, several periods of western society have been marked by waves of romanticist protests against scientific and industrial development. They have been hostile to the Baconian-Cartesian ideal of positive objective knowledge and universal reason. The Romantic episteme posits knowledge and meaning as being culturally differentiated, or at least always mediated by a specific language, as always situated in unique historical settings.[97]

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[92] See the first page of Bose *Responses.*
[93] Mukherjee (Visvapriya) *op. cit.,* p. 51.
[94] First page of Bose , *Nervous Mechanism.*
[95] Bose *Response,* first page.
[96] Nandy, *Alternative Science,* p. 44.
[97] Thomas Blom Hansen, "Inside the Romanticist Episteme", *Social Scientist,* Vol. 224, Nos.1- 3 January, March 1996, p. 60.

Romantic ideology has been explained as a response to cultural crisis, when the individual becomes uprooted, isolated, atomized and confronted by rapid social and economic changes. It has also been seen as a response to a perceived or actual dissolution of traditional values and institutions.[98] One such period followed the French revolution, which shook the foundation of cultural and political order in Europe.[99] However, it was the industrialisation of nineteenth century which actively polarised the intelligentsia of Europe into the scientific technical rationalists and the cultural romanticists or geistewissenschaften.[100] Dilthey sought to develop an alternative to positivism; he infact started the formal debate between the two traditions.[101] In the 1890s philosophers like Henri Bergson and William James attempted to reveal the limitations of scientific reason through the subjective warmth and elusiveness of art, poetry and literature.[102] The trend continued throughout the early twentieth century, particularly following the First World War, the great Depression of 1930s and in Germany as a reaction to the preparation for the expansive war.[103]

In the early years of twentieth century and the period following the First World War, Bose a scientist from the 'spiritual' east had a special appeal to Europe. Individuals like Nivedita and Patrick Geddes, who shared many of the romanticist concerns, tended to see in Bose's ideas an anti-thesis to the mechanistic, reductionist Western world view.

However, as Gouldner argues, Romanticism was emancipatory, non-conformist, individualist while being at the same time *essentialist* as well. Idealist philosophy was attempting to re-enchant the human world by insisting on the centrality of agency, of human research for individual and cultural originality, of imagination and spirit. Herder applied this concept of originality and innerness to

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98 Aant Elzinga, *Essays on Scientism , Romanticism and Social Realist Images of Science,* Dept. of Theory of Science, University of Goteborg, Report no. 145, 15. June, 1984, p. 69.
99 *Ibid.,* p. 68.
100 *Ibid.,* p. 69.
101 *Ibid.,* p. 70.
102 *Ibid.,* pp. 68-69.
103 *Ibid,* p. 69.

culture bearing groups as well. A culture-bearing group like the French, or the Germans were expected to be true to themselves, to their inner spirit.[104] Thus the same essentialism that marked the works of Orientalists and then influenced Bose's spirit of 'Indian Monism'; was shared by the Romanticist who now appreciated his work.

Nivedita thus sought in Bose's work the reflection of the purest forms of Upanishadic Hinduism. She edited *Response* but was not satisfied with it. She was planning with Bose a 'greater work': "Such as only this Indian man of Science is capable of writing on Molecular Physics".[105] That would, she believed, through the knowledge of the era of *Upanishads*, demonstrate to the materialist west that the vast accumulation of physical phenomenon also "are one-appearing as many".[106]

For Patric Geddes, the issue was slightly different, for he believed in Vitalist biology and had a faith in the 'other' scientific tradition within the west. These 'other' traditions have a long history within Europe, sometimes as a part of the Romanticist tradition, hand sometime as an independent tradition. As Nasr has argued, there remained in Europe a group of philosophers and even scientists who did not submit completely to the mechanistic view of nature. In the decades preceding and following 1800 there existed in Germany a science related to Romanticism and *Naturphilosophie* that did not reject empiricism but rather sought to integrate the details contained in eighteenth-century encyclopaedias of natural history into a larger whole, reflecting the unity of nature. Practitioners of this new kind of science refused to submit to the mechanistic interpretation of the world and saw the order of nature as related to the hierarchy and the wholeness characterising traditional cosmology. Attacked fiercely by positivist scientists, it declined rapidly by the middle of the nineteenth century. Its influence remained on a very marginal scale in the twentieth century in certain schools of medicine and among those scientists who were in the search for the metaphysical meaning

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[104] Hansen *op. cit.*, pp. 62-63.
[105] Nandy, *Alternative Science*, p. 62.
[106] *Ibid.*

of physics.[107]

Geddes, a critic of the mechanistic, reductionist science, saw in neo-vitalist botany the possibility of a dialogue with an organic tradition.[108] Here he saw a biological world-view that resembled the cosmic world. He thus identified two Wests: one was the mechanical-colonial, the other was Vitalistc- ecological. His focus was not on a complete negation of the West, but in reviving its alternative tradition.[109] In this revival, two factors could play important roles, one was the discipline of biology in the west, the other was Indian spirituality and mysticism. The ideal combination naturally would be the study of biology by Indians, because they had retained their spiritual kinship with nature, unlike the materialist west. That was the essence of India to Geddes.[110]

Thus to Geddes, the answer to the crisis of Europe could come from India, of course a rejuvenated India. India must go back to its own true self to Vedic culture, as well as pursue the study of European biology. In Geddes's scheme of things such a process would bring about the ideal situation---the revival of the East and the reincarnation of the West, "With the renewal of your own party, your own philosophy, renew your ancient science, infuse and deepen our keener yet less profound Western thought."[111]

It is clear now, why Geddes saw Bose as the man who could show the way. Similar feelings were gradually cherished among a large section of European intellectuals. On Bose's seventieth birthday Romain Rolland wrote to Bose,

> In your make will be seen in the course of this century that India without sacrificing anything of the richness of the profound soul, of that inner world which was bequeathed to her by centuries of thought, will add thereto the intellectual weapons of Europe, which will be given to her to make her perfect for the mastery of nature and for the glory of the Atman.[112]

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[107] Nasr, *Order of Nature, pp. 143-144.*
[108] Viswanathan, "Magus, A Mysterious Wise man from the West", *The India Magazine,* January, 1998, pp. 20.
[109] *Ibid.*
[110] *Ibid,* p. 21.
[111] *Ibid,* pp. 21-22.
[112] *Bose Centenary,* p. 72.

Somewhere in Rolland's words we are reminded of Bankim and Sircar's search for the 'perfect man' combining the best of the Eastern and the Western worlds. In the growing anxieties over the ethical problems of western science, particularly in the inter-war period, intellectuals like Einstein, Bernard Shaw and Kropotkin, looked upto Bose as the man with the unique capacity to provide an answer.[113]

Bose was willing to shoulder the burden. This had given him a special identity and a greater legitimacy to his work. In the Presidential Address to the Indian Science Congress of 1927, aptly named *Unity of Life*, Bose reiterated Geddes's scheme of the meeting of the East and the West: "Hellenistic Greeks and Eastern Aryans had met here in Taxila to exchange the best each had to offer. After many centuries the East and the West had met once more and it would be the test of the real greatness of the two civilizations that both should be finer and better for the stimulus of contact."[114]

In this contact, the East was endowed with its special privilege--its imaginative, metaphysical mind was particularly suited to biological work. That was in Bose's words the 'Indian Gift': "In order to discover the life mechanism in the interior of the tree one has to become the tree and feel the throbbing of its beating heart...."[115]. Assuming that he was gifted with this special 'Indian' sensitiveness, Bose sought to grasp the pulse of life, to be one with nature.

An analysis of Bose's later works shows that although in *Responses* he was talking of the similarity and unity of both the living and the non-living, he never worked on the so-called 'non-living' again. While his project was to transcend the boundaries between the animals, the plants and the inert objects, his work was ultimately reduced to showing the similarities only between animals and plants. After *Responses* his next investigation was directed towards obtaining evidence of responsive mechanical movement in these plants by devising new instruments. The most important fact established in *Plant Response* (1906) was

[113] Nandy, *Alternative Science*, p.63.
[114] "The Unity of Life", Presidential Address, *Proceedings of ISC*, 1927, Vol. 14. P. 5.
[115] *Ibid*, p. 6.

deeper link with plant -life.

In the tree, Bose saw the metaphor of life. Describing the sense organs of the tree, he wrote this striking passage: "Whence did the tree derive its strengths by which it emerges victorious from all pain? It is the strength derived from the place of its births, its power of perception and quick readjustment to change and its inherited memories of the past."[122]

To Bose the tree had become a metaphor for his nationalism as well. He sought to draw inspiration for the nation from the strength and roots of the tree:

> Is there any strength for the constant renewal of our national life? Is the tradition of the past dead and forgotten, or is there a latent power of national memory which is to be awakened once more in a new and vivified impulse? The high character and achievements of our people will today prove to be the greatest constructive force. It will not be through transient emotion, but through persistent efforts, that they will succeed in building the Greater India yet to be ...[123]

This link between the tree and the nation show how biology and plant life had become crucial to Bose's thought and life. This also shows how his work on electric touch on tin and zinc plate had led to an obsession with plant life. His science and his nationalism were now meshed into single project. Elsewhere, in the convocation Address at the University of Mysore, he established the links formally:

> The tree may be likened to a State consisting of countless living unity, different group of which co-operates in the discharge of definite functions for the advantage of the community; any break in harmony in the organism means the destruction of the commonwealths. The tree persists because it is rooted deeply in its soil which provides its proper nourishment and endows it with strength in struggling against all dangers that threatens it.[124]

What had also prompted this shift to plant-physiology was his growing closeness with European neo-vitalists like Geddes and others. Moreover, by

[122] Bose, *Plant Autographs and Their Revelations*, The Macmillan Company, New York, 1927, p. 106.
[123] Bose, "The Unity of Life" Malaviya Commemoration Vol. , 1932, *Bose Speaks*, p. 47.
[124] "Convocation Address at the University of Mysore on the 3rd November, 1927", *Ibid.*, P. 96.

making the 'voiceless' plants speak, by articulating their inarticulate language, Bose appear to restore the lost' mystecism of science, to 'humanize' its mechanical world-view. At the same time, plants were more sensitive to external stimuli than non-living objects, facilitating such comparisons with the animal world. Bose had thus moved towards a discipline which promised a greater legitimacy to him, to his passion, work and culture. The thematic and the problematic of his work were now synchronised. His work on plants, he believed, reflected the spirituality of science. To that extent Sircar's project had been fulfilled, Bose asked:

> In realising this unity of life, is our final sense of mystery deepened or lessened? Is our sense of wonder diminished when we realise in the infinite expanse of life that is silent and voiceless, the foreshadowing of more wonderful complexities? Is not rather that science evokes in us a deeper sense of awe? Does not each of her new advances gain for us a step in that stairway of rock which all must climb who desire to look from the mountain tops of the spirit upon the promised land of truth?[125]

In the later years, particularly from 1915, we see in Bose's writings a rhetoric of the the essence and greatness of Indian spirituality and its vitality to modern science. A typical example would be his speech at the Benaras Hindu University in 1916.

> For there is something in the Hindu culture which is possessed of extraordinary talents and strength, by which is resisted the ravages of time and the destructive changes which have swept over the earth. And indeed a capacity to endure through infinite transformations must be innate in that mighty civilization which has seen the intellectual culture of the Nile, the Valley of Assyria, and of Babylon, wax and wane and disappear, and which to-day gazes on the future with there same invincible faith with which it met the past.[126]

Bose had worked out the compatibility of Eastern spirituality to modern science, along lines similar to that of Sircar- a heady mix of eastern imagination with Western experimental rigour. We are reminded of Sircar's balloon and the string when he said, "For the accomplishment of any great scientific work there

[125] Bose, *Plant Autography*, p. 73.
[126] *Sir Jagadish Chandra Bose His Life, Discoveries and Writings*, G. A. Natesan and Co. Madras, p. 40.

must be two different elements and these must be evenly balanced; ...these elements are: first a great imaginative faculty, and second: a due regulation of that faculty in pursuance of rigid demonstration."[127] In 1900 he had told Nivedita, "Everyone knows we Indians have brilliant imagination, but I have to prove that we have accuracy and dogged persistence besides".[128]

When Bose visited Europe for aid for his institute he was warmly received by those sections who were sympathetic to his project.[129] The sentiments that Bose now aroused in the west were almost predictable. *The Times* wrote:

> In this (scientific research) than in other fields of knowledge India has her special contribution to make. Sir J. C. Bose's work has shown that through her meditative habit of mind she is peculiarly fitted to realize the idea of unity and to see in the phenomenal world an orderly inverse, and this habit confers the power to hold the mind in pursuit of truths in infinite patience.[130]

Another article in *The Times* stressed how in Bose's work the best of West and East had converged.

> Sir Jagadish Chunder Bose is a fine example of the fertile union between the immemorial mysticism of Indian philosophy, and the experimental methods of Western Science. Whilst we in Europe were still steeped in the rude empiricism of barbaric life, the suitable Eastern had swept the whole Universe into a synthesis and had seen the one in all its changing manifestations.[131]

Yet, Bose in his efforts towards bridging the two worlds of Indian spirituality and western science had raised certain questions within Indian nationalist discourse which even challenged his own status within it.

An important question was: Did his researches ultimately lead to a celebration of western science or Indian tradition? The two were not necessarily compatible: within nationalist discourse the celebration of tradition was often through a critique of modernity and a rejection of western science. This tension

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[127] *Ibid.*, p. 27.
[128] *Bose Birth Centenary*, p. 17.
[129] Geddes, *op. cit.*, p. 248- 250.
[130] *Ibid.*, pp. 242-3.
[131] *Ibid.*, p. 249.

was sharpened further by Bose's work. His attempts at a practical combination of the two resulted in an explosive situation. The debates published in *Prabasi* and *Bangabasi* would illustrate that.

In 1921 Mahesh Chandra Ghosh wrote an essay, "Sensitivity of Plants", in response to Bose's researches.[132] He pointed out that the question of sensitivity of plant which had recently been demonstrated by Bose was nothing new to Indians, this, in fact, was the wisdom of their saints. Sashibhusan Biswas while discussing Ghose's arguments pointed out that *Bhisma* (The great warrior in *Mahabharata*) had explained in detail these ideas of plant - life.[133] In 1925 a piece came out in *Bangabasi* discussing Bose's discoveries on heart-beat among trees. Arguing that such ideas were present in traditional Indian texts, it challenged the novelty of Bose's discoveries. Its novelty was, it asserted, only to the West which was yet to be familiar with such ideas. To the East Bose was hardly presenting anything original. The speciality of Bose was in making these high ideals of Eastern spirituality easily observable and conceivable to the West with the help of the new instruments that he devised. Thus rather than learning science, East should go back to its own tradition where all these ideas were present.[134] The situation was now somewhat paradoxical - the reading of Bose's scientific texts was leading to a rejection of that very science:

> All the aspects of plant life are discussed in detail in the Mahabharata. The Hindus if they read it, would not required to look up to the new discoveries of science. With the passage of time many have lost their faith in our classical knowledge, so even the insignificant discoveries of Western science generate their great wonder. This country will be truely benefited if by Sir Jagadish's discoveries these men revive their lost faith in the ancient texts of the Hindus.[135]

Such a position was certainly contested by those who retained their faith in science. In response to this piece an anonymous letter was published in *Prabasi* which objected particularly the idea that the *Mahabharata* could

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[132] *Prabasi*, Ashwin, 1328, p.786.
[133] *Ibid.*, Agrahayan, 1328, p.199.
[134] Quoted in *Prabasi*, Poush, 1332, pp.420-421.
[135] *Ibid.*

substitute for modern science. The writer commented, "from my childhood I have been reading Kashiram Das's Mahabharata and Kaliprasanna Singha's translation of it from Sanskrit. Till now have been enlightened by any ideas of plant physiology from them."[136] The editorial of *Prabasi* came up in support of such views. Ridiculing *Bangabasi's* claims it retorted, "Soon, the universities and scientists of the West, instead of writing to Acharya Bose for his instruments, would write to the office of 'Bangabasi'. Acharya Bose should also be cautious. Why should he waste his time and energy on something which could be so easily available from Bhabani Charan Datta street?"[137] The editorial pointed out that such preposterous ideas were quite generally held. The followers of the Arya Samaj believed that telegraphs and other modern inventions are all mentioned in the Vedas. It added that such revivalist tendencies were noticeable in other countries too. One Iraqi newspaper had claimed that in the *Arabian Nights* there were mention of flying carpets which were similar to modern day aeroplanes. Another Arabic newspaper had written in reaction to Bose's discoveries "What is so special in this? In our Al Kalah (Arabic Novel) there is the mention of singing - trees which used to sing on their own for the princesses. And now we have acclaim that Mr. Bose has developed an instrument only to measure the heart-beats of trees!"[138] The editorial ended with a short comment, "what a shame that in the garden of Bose Institute there is not a single singing - tree!"[139]

These exchanges show that there were two kinds of reactions of Bose's work. The first was the celebration of traditional Oriental thought against modern science and the other was an attempt to legitimise modern science in India through Bose. These were attempts to define modernity within Indian nationalism. *Prabasi*'s, apprehension reflected the rationalist approach to instil a scientific ethic within the country. As early 1903, it criticised the "ridiculous commentaries an Bose's work both in India and abroad that were going wild with their imagination regarding the life and death' of metals".[140] Mention can also be

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[136] *Ibid*, p.420..
[137] *Ibid.*
[138] *Ibid.*, p.422.
[139] *Ibid.*
[140] *Prabasi*, 1310, no.I, pp.20-24.

made of Jagadananda's reading of Bose which stressed largely its scientific context and status. The other reaction reflected the attempts to undermine precisely that. Bose's endeavours, similar Sircar's ideals of spiritualising science, had interestingly articulated itself in a rejection of science. In a complex world where 'tradition', 'spirituality', 'materialism' all reinforced each other, Bose's ambitious project was interpreted in multi-farious ways. But what ultimately made his work attractive to the revivalist sections was his acceptance of spirituality as a sovereign territory of the East, which Sircar had avoided. The intensity of such feelings is evident in the strong reaction to *Prabasi*'s editorial among its readers. A number of letters asserted the wisdom of ancient texts like the *Mahabharata* against the claims of modern science. The complicated lineages of such assertions also becomes apparent here. Nandalal Singha's letter drew inspiration from the fact that Bose's *Responses* too had started with that famous Vedic sermon. Thus Bose himself got implicated in this development. Singha then went ahead to show that the Vedic texts even mentioned the presence of 'brain' in plants,[141] and that William Jones' writings too proved that Indians had practised botany and chemistry from 'time immemorial'.[142] Thus not only the excellence of Indian spirituality but even Indian practises of exact sciences could be celebrated together.

In reply to such criticism, the editorial of *Prabasi* reaffirmed the other point of view. It assserted the distinction between the 'spirituality' of Indian thought and the 'scientificity' of Bose's discoveries. The evidence in Mahabharat, it insisted, were not scientific facts, but spiritual realisations. Bose had established them as scientific facts through modern science. This is why Bose's contribution was unique. The need was, it urged, to realise the scientific value of Bose's work: he was the first to demonstrate the 'conductivity', 'contractibility' and 'rhythmicity' among plants.[143]

What emerges from these contestations, is how science was being located as the dominant mode of thought, even while refuting itself. The other

[141] *Ibid.* Magh, 1332, pp.516-517.
[142] *Ibid.* p.515.
[143] *Ibid.* p.518.

development was a certain essentialisation of the idea of 'tradition'. Within both the camps, tradition was getting defined in terms of the classical, ancient Vedic wisdom. The debate was on whether it was superior or parallel to science. It was through such a characterisation that the cognitive content of science ultimately came to terms with that 'tradition'. Thus, while science itself continued to be debated and rejected in the popular arena, the museumised tradition now posed a lesser threat to its cognitive status. This shaped the course of the 'other' science of Bose which attempted to infuse the two. We will take that through our study of the Bose Institute which attempted to institutionalise the project.

Bose Institute

Both Nivedita and Bose had dreamt of a research institute, which would realize the possibilities of science and the regeneration of India.[144] Although Nivedita did not live to see it, the Institute was ultimately established on 30th November, 1917. Bose's inaugural speech at the Institute reflected how he had come to grasp his work, science and the nation. The Institute was to renounce materialist or utilitarian ideals. Bose clearly identified the bane of European civilization:

> Such material activities have brought as their first great accession of power and wealth. There has been a feverish rush even in the realm of science for exploiting application of knowledge, not so often for saving as for causing destruction. In the absence of some power of restraint, civilization is now trembling in an unstable pose on the brink of ruin....[145]

The true ideals of his institute would be a self-less, disinterested search for truth, a reiteration of the ideals of Asiatic Society and IACS.

> The motive power for this is to be found not in personal ambition but in the effacement of all lethalness and in the uprooting of that ignorance which regards, anything as gain which is to be purchased at another's loss. This I know, that no visions of truth can come except in the absence of all sources of distraction, and when the mind has reached the point of rest. And for my disciples I call on those very few who will

[144] Geddes, *op. cit.*, p. 221-272.
[145] Bose, *Plant Autography*, "Appendix", pp. 231-733.

> devote their whole life with strengthened character and determined purpose to take part in that infinite struggle to win knowledge for its own sake and see Truths face to face.[146]

True to his emerging sense of 'Indianness' Bose searched for and Indian inspiration for this insulation of scientific pursuit. At B.H.U. (1916) he argued that Indian spirituality was particularly suited for this necessary 'detachment'. This spirituality was symbolised in Asoka, "the greatest warrior king became suddenly transformed under its dominating influence even at the moment of greatest victory".

The scientist in search of sublime truth could draw inspiration from Asoka who so easily renounced material gains for his own spiritual search,

> Poised as he is between the infinity of the past and the infinity of the future between universes of worlds and universes of atoms – can anything be worth his while for so sorry a prize? Can his mind be satisfied with anything less sublime than to be merged in the rhythmic sweeps of the world-spirit itself?[147]

The image of the 'Sanyasi' which the *London Spectator* had seen in him almost two decades earlier had now taken its full shape.

However, the Bose Institute unlike the Asiatic Society had a social commitment in India, "The advancement of science is the principal object of this Institute, as well as the diffusion of knowledge".[148] The Institute also had to be particularly 'Indian'. It drew it inspirations from the seats of learning of ancient India, "In this I am attempting to carry out the tradition of this country, which, so far back as twenty-five centuries ago, welcomed all scholars, from different parts of the world, within the precincts of its ancient seats of learning, at Nalanda and at Taxila."[149]

The Institute was to be 'Indian' also in its method of enquiry. That was in Bose's words 'a synthetic science' which could introduce order in the apparent

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[146] *Ibid*, p. 233.
[147] "Address at B.H.U., "1916", *Bose Speaks*, p. 159.
[148] *Ibid*, p. 234.
[149] *Ibid*,

chaos of nature. It was this type of enquiry that was ideally suited, Bose believed, to the Indian mind,

> The excessive specialisation in modern science has led to the danger of losing sight of the fundamental fact that there can be but one truth, one science, which includes all the branches of knowledge. How chaotic appear the happenings of Nature! Is nature a Cosmos in which the human mind is some day to realize the uniform march of sequence, order, and law? *India through her habit of mind is peculiarily fitted to realise the idea of unity, and to see in the phenomenal world an orderly universe.* (emphasis mine)[150]

He himself. Bose stressed, endowed with that particular 'Indian' capacity had grasped the concept of Unity. Thus Bose now saw his career's work as a manifestation of his 'Indianness'

> It was this trend of thought that led me unconsciously to the frontiers of different sciences and shaped the course of my work in its constant alteration between the theoretical and the practical, from the investigation of the inorganic world so (sic.) that of organized life and its multi- farious activities of growth, of movement, and even of sensation. Thus the lines of physic, of physiology, and of psychology converge and meet. And here will assemble those who seek oneness amidst the manifold.[151]

Moreover, by the 1920s the enthusiastic western scientific community had fully come to terms with Bose and his science. His Indianness and his plant physiology had been successfully incorporated within the dominant frameworks of European epistemology. His work now appeared to fall into a predictable pattern. Plant physiologist Prof. Haberlandt, initially opposed to Bose now found his work acceptable,

> It is no more an accident that it should have been an Indian investigator who has in high a measure perfected the methods of the physiology of irritability. In Prof. Bose there lives and moves that ancient Indian spirit, which sees in every living organism a perceptive being endowed with sensitiveness. It is remarkable that the same old Indian spirit which has carried to its utmost limits metaphysical speculation and introspection wholly withdrawn from the world of sense ... that the same spirit should have brought to light on its modern representative, who is our quest

[150] *Ibid*, p. 235.
[151] *Ibid*.

> today, such an extraordinarily developed faculty for observation and such an ecstasy in scientific experimentation....[152]

Interestingly, enough the institutes we have studied so far, the Asiatic Society, IACS, and Bose Institute had certain interesting commonalties, inspite of their obvious differences. Each in their own ways were opposed to the modern West. This disenchantment had brought about an element of introspection. They looked at science as a non-utilitarian, non-materialist pursuit of pure truth. It should be added though that the Asiatic Society was firmly entrenched in the mechanical world-view of science the other two, due to their different historical locations, had sought to question it, Yet, at another level, both the Bose Institute and the Asiatic Society had sought to extract certain meanings from Indian past to assuage their romanticist concerns about an industrialised Europe. Their readings of Indian tradition were deeply coloured by these emotion. Romanticism appeared particularly compatible and attractive to Bose and his fellow nationalists because it provided an important cultural critique of the West while to the Asiatic Society it was promise for another world. It was thus a mutual dependence between the Indian and the European romanticists that shaped these scientific concerns.

But such a link was ultimately going to curb the larger possibilities of Bose's project. As the 'easternness' of his work primarily assigned to him by the west and the nationalists and which he subsequently took up was actually an essentialised dominant one, it was destined to paralyse his search for an alternative. Indian tradition and India amounted to a monlithic, sanitised Vedic spirituality to Bose. Once he had experimentally claimed that the similar response in living and non-living proved this unity of life, the thematic paradigm of his research agenda had become complete After *Responses* we see him proving the same conclusions through repeated and different experiments which amounted to the consolidation of the larger dominant notions. Thus the greater possibilities of his work could never be realized. That needed a more dynamic dialogue with the alternative attitudes of nature.

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152 *Bose Birth Centenary*, p. 32.

Once the Vedic tradition was successfully incorporated within experimental science-- the 'East' or 'India' ceased to pose any challenge to his science, to the effect that these alternative ideas ultimately had only ornamental value to his work. This is best illustrated in the scheme of research that Bose proposed for his Institute. According to him it was to explore the responses of plant which would carry their implication in physics, physiology, medicine, agriculture, psychology etc. The programme did not elaborate own the search for an alternative, in fact it had ceased to play an active role,

> The work already carried out in my Laboratory on the response of matter, and the unexpected revelations in plant life, foreshadowing the wonders of the highest animal life, have opened out very extended regions of enquiry in physics, in physiology, in medicine, in agriculture and even in psychology.... In the study of Nature there is a necessity for a dual viewpoint, an alternating yet rhythmically unified interactions of biological thought with physical studies, and of physical thought with biological studies. The future worker with his freshened grasp of physics, his fuller conceptions of the inorganic a world as indeed thrilling, with the promise and potency of life, will redouble his former energies for work and thought. He will be thus in a position to winnow the old knowledge with finer sieves, to re-search it with enthusiasm and subtle instruments. His handling of these will at once be vital and more Kinetic, more comprehensive and more unified.[153]

This research agenda reflected some of the major concerns of contemporary natural and biological sciences. As shown by Nandy, it was becoming increasingly apparent that an interdisciplinary approach could provide new theoretical breakthroughs.[154] Bose's 'India' had thus become relevant to such concerns as well. His essentialism did not allow a dynamic, radical dialogue with modern science and the articulation of alternative visions of nature. Such a propulsion could have fulfilled the revolutionary promises of Bose's project. In the absence of such a dynamic interaction it could be converted into a normal science activity with the consolidation of new paradigms.

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[153] Bose, *Plant Autograph*, pp. 233-234.
[154] Nandy, *Alternative Sciences*, p.64.

CHAPTER - 6

Researching for an Indian Science-2
P. C. Ray and his Hindu Chemistry

The East has not always been East and the West, West.

- P.C. Ray[1]

Prafulla Chandra Ray published *History of Hindu Chemistry* in 1902, the same year J. C. Bose's *Response* was published. But Ray's book marked a very different path in the search for a 'nationalist' science. Through this book Ray undertook a historical analysis of the materialist past of India and thus sought to question some of the essentialised concepts about the East and the West on which Bose had grounded his work.

Born 1861, P. C. Ray's career was marked by an active participation in the Indian nationalist political struggle, from the days of Swadeshi to the times of Gandhi. His political involvement started quite early, in England, where Ray had first gone to obtain his doctorate degree. Some time in 1885, Ray had participated in an essay competition on "India before and after the Mutiny".[2] He soon realised that he needed more than a cursory reading of a few history books. He read Fawcett's *Political Economy and Essay on Indian Finance* as well as columns of the *Hindu Patriot, Parliamentary Debates,* etc. Ray submitted the essay and was awarded the price.[3] The interest stimulated by the essay writing competition led to a new political awareness.

Back in India after obtaining his doctorate degree, he was faced with the common problems of unemployment of and discrimination against the Indian youth by the colonial regime. For a year, from August 1888 to the end of June 1889, Ray was unemployed, "a chemist *minus* his laboratory" he felt that he was

[1] Ray, "The Tantrists, The Rosicrucians and the seekers after Truth", *Modern Review,* 161 1906, p.237.
[2] Ray, *Life and Experiences*, p. 61.
[3] *Ibid.*, pp. 61-62.

like "Samson shorn of his locks".[4] In 1889 he was appointed was at the Chemistry department of Presidency College.[5] Simultaneously Ray became active in the Bramho Samaj movement and organised the *Brahmabandhu Sabha.*[6] He had a keen interest in politics as well. As a government servant he could not join the Swadeshi movement of 1905 but, as he said, "from my recess in the laboratory I watched it steadily and I need scarcely add my heart went out to it..."[7]

His baptism into active politics came through his contact with first Gokhale and then Gandhi, besides his other political 'gurus' Ananda Mohan Bose and S. N. Bannerjee. Ray was fascinated by Gokhale's knowledge of politics and economics and by his collections of books. What particularly impressed Ray about Gokhale was that his involvement in politics was always backed by sound academic interest in politics, economics and political history.[8]

With Gandhi, his involvement was different. Ray was attracted by Gandhi's "magnetic personality" his "devotion to asceticism",[9] his commitment, strength and conviction. It was from Gandhi that Ray received the most important message in his life: "Truth lived is a greater force than truth merely spoken"[10]

Although, as a scientist, Ray did not consider himself by 'temperament and by nature' to be a politician, yet his career epitomises a scientist's active participation in public life. His firm belief in life outside a test tube made him join actively in the Indian struggle against colonial rule and poverty. In the 1920s, he frequently toured the entire country, arguing for the need to maintain the National Schools, to use *Khadi* and to launch a war against untouchability.[11] Ray was present at the Coconada Congress Session of 1925,as a delegate. In one of

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[4] *Ibid.*, p. 80.
[5] *Ibid.*
[6] *Ibid.*, p. 85.
[7] *Ibid.*, p. 139.
[8] *Ibid.*, pp. 125-126.
[9] *Ibid.*, p. 126.
[10] *Ibid.*, p. 128.
[11] *Ibid.*, p. 228.

the sessions he had to even act as a Chairman.[12] Ray, had also participated in the Rowlatt Satyagraha giving his first public speech at the Town Hall , Calcutta.[13]

Apart from these activities Ray also wrote a series of essays on the poverty and economic drain of India. In an article "Bengal- the Milch Cow", he showed how the villages were the worst sufferers of the British rule.[14] Drawing from the Hunter's *Annals of Rural Bengal* (1897) he showed how the 'Plassey Drain' had, led to an acute drain of wealth in the form of revenues from the villages of Bengal.[15] However, as a scientist, his main critique of the British rule was directed against its science policy. In his Presidential Address to the Indian Science Congress in 1920, he showed how Indians were excluded from the scientific service with a "studied care".[16] This arrested the intellectual growth of the Indians. At the same time this lowered the standard of scientists working in the country as either a "raw, untried graduate is brought out from England " or an old "senile" Englishman was given the responsibility. Not only were Indian talents not encouraged, often incapable white men were given important responsibilities.[17] In contrast to this, as proof of Indian talent in teaching and learning science, Ray cited the case of University College of Science, Calcutta, which grew out of the efforts of Rashbehari Ghose and T. N. Pal in 1916.[18]

Ray himself had demonstrated his considerable organisational skills when he established the Bengal Chemical and Pharmaceutical Works- a significant *Swadeshi* enterprise. It was around 1891-92 that he became worried about the lack of business acumen among Bengali youth and the increasing dominance of outside communities in commercial activities. He had also noticed that the knowledge of science was seldom put to any commercial or industrial use by the youth.[19] These realisations nurtured by the Swadeshi spirit of the times, led him to start the Works. This we shall discussed in the next chapter.

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[12] *Ibid.*, p. 230.
[13] *Ibid.*, p. 231.
[14] Ray, "Bengal the Milch Cow," *Life and Experiences*, p. 428-439.
[15] *Ibid.*, p. 430.
[16] "Presidential Address" *Proceedings*, 7th 1920, pp. VIII - XII.
[17] *Ibid.*, p. X.
[18] *Ibid.*, p. XII.
[19] *Life and Experiences*, pp. 92-93.

Our main concern here is another significant achievement of Ray amidst all this political, scientific and entrepreneurial activities – writing the two volumes of the *History of Hindu Chemistry*[20] His profession as a chemist and his keen interest in history had made reading of the history of chemistry one of his favourite hobby. Impressed by Berthelot's *L'Alchimistes Greeks* (History of Greeks Alchemy), he started communicating with the French scholar.[21] Ray himself had noticed that traditional Indian medical practices demonstrated the knowledge of various metallic preparations. Realising that European scientists were not aware of this fact, Ray wrote to Berthelot about this, who encouraged Ray to research on the theme. Thus Ray ventured on his discovery of India's scientific past, aided by Pandit Nabkanta Kavibhusan, who searched the Sanskrit documents at Benaras for traces of ancient knowledge of alchemy.[22] The first volume came out in 1902 and the second in 1907.

Hindu Chemistry was not just an outcome of Ray's interest in antiquity. It was a manifestation of his nationalism as well: an effort to establish the materialist past of India and thus contest the superiority and antiquity of European scientific knowledge. To that extent it was a challenge to the predominant Orientalist scheme of spiritual East and material West and an attempt to establish a materialist East. At the same time as a scientist, Ray sought to legitimise and familiarise science to Indian civilization through this project.

Hindu Chemistry can be best appreciated if one grasps the nationalism that inspired it. Ray was convinced that a nation have its own independent rational knowledge base, particularly in science. He made that clear in the first volume, "The capacity of a nation must be judged by what it has independently achieved in the several fields of knowledge and branches of literature – Mathematics, Geometry and Astronomy; Phonetics, Philology, Grammar, Law, Philosophy, and Theology."[23]

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[20] *A History of Hindu Chemistry: From the Earliest Times to the Middle of the 16th Century A. D.* Vol. I, Calcutta Chuckerbutty Co. and Keagen Paul, 1902; Vol. II 1925.
[21] *Life and Experiences*, pp. 115-117.
[22] *Ibid.*, p. 178.
[23] *Hindu Chemistry* ..., Vol. I, p. XL.

More importantly, the confirmation of an ancient glorious past where science was nurtured could ensure the prospect of an equally bright future. The knowledge of past glory would stimulate the people to regain their true self:

> The Hindu nation with its glorious past and vast, latent potentialities may yet look forward to a still more glorious future, and, if the perusal of these pages will have the effect of stimulating my countrymen to strive to regain their old position in the intellectual hierarchy of nation, I shall not have laboured in vain.[24]

His main argument throughout the two volumes is that India had an independent, indigenous and parallel history of scientific tradition from the early past. Thus his main critique was pitched against the dominant Euro-centrism of French Orientalists like M. Sylvain Levi who had argued that Indian knowledge of botany and medicine was basically a product of Greek influence. Ray's discussion on *Charaka* and *Susruta* was an attempt to establish that they were either anterior or parallel to Greek knowledge of medicine.[25] He showed that both texts were actually of Vedic origins and thus had nothing to do with Greece as many Orientalists were arguing.[26]. Ray's main thesis was on alchemy and the science of mercury (*Rasayana*) and he sought to locate independent Indian roots of these sciences. Contesting the argument that alchemy had come to India from Greece via Arabia, he suggested that Indian alchemy predated Arab influence. He even questioned his mentor Berthelot who had argued that the use of mercury and heavy metals in therapeutic use was initiated by Paracelsus. Ray pointed out, that such therapeutic uses of mercury were known to India at a much earlier date and that Paracelsus was only initiating it in the West.[27]

Thus in Ray's work we see a more complete articulation of the nationalist logic than that of Bose or Sircar. His career on the one hand was marked by an active participation in the anti-imperialist struggle through swadeshi, *charkha,*

[24] *Life and Experiences*, p. 164.
[25] *Hindu Chemistry ...*, Vol. I, pp. XL - LIII
[26] *Ibid.*, pp. XXVII – XXVIII.
[27] For details see Dhruv Raina, "The Young P. C. Ray and the Inauguration of the Social History of Science in India, (1885- 1907)", *Science Technology and Society*, Vol. 2, no. 1, 1997, pp. 12-22.

national education etc. On the other hand his *Hindu Chemistry* challenged the predominant European attitude towards the Orient which defined its essential character in opposition to the Occident. For Ray, the East had a scientific and materialist past as well: "It is generally taken for granted that the Hindus have always been a dreamy, metaphysical people, prone to meditation and contemplation...In ancient India, however, physical science found her votaries. India was the cradle of mathematical sciences including arithmetic and algebra".[28]

Ray went on to argue that even the West had its spiritual past: "Modern Europe is materialistic, but she has not disdained in the past to 'plunge in thought'... Ancient Greece had orphic mysteries. They were developed into a religious and ethical system by Pythagoras..."[29]

Through this reversal of the character of the Occident and the Orient he came to his final proposition of a civilizational synthesis. He argued that Greece and India had similar histories where science figured prominently. In other words he sought to establish the universality of scientific knowledge, which constituted an inter-civilizational brotherhood: "Kanada, Patanjali and Nagarjuna of India and Heraclitus, Empederles and Plato and the rest – they all form a wholly fraternity, ..."[30]

In a recent essay Dhruv Raina locates Ray's project as a clear break from the Orientalist paradigm,[31] marking and initiating a new scientific discourse of colonial India. Ray's works broke with the fundamental postulate of Orientalism that proposed an ontological and epistemological divide between the Orient and the Occident.[32] Secondly, Raina sees in Ray's *Hindu Chemistry* the initiation of the writing of social history of science in colonial India. This was a second

[28]Ray, "Progress of Chemistry in Ancient India", *Science and Culture,* Vol. II, No. 16, April 1937, p.497.
[29] Ray, "The Tantrists, the Rosicrucian..."p.237.
[30] *Ibid., p. 239.*
[31] Raina, "The Young P. C. Ray ...".
[32] Raina, "Evolving Perspectives on Science and History: A Chronicle of Modern India's Scientific Enchantment and Disenchantment (1850-1980)", *Social Epistemology,* Vol. II, No. 1, 1997, p. 8.

departure from the Orientalist literature on India which tended to de-contextualise Indian knowledge from its social matrix. In search for an answer as to why a scientific revolution did not take place in India, Ray traces the cause to the consolidation of the caste system and social rigidities of medieval times. This argument located the problem both beyond the question of Eastern and Western 'minds' as well as the nature of scientific practice in India.[33]

Raina's arguments regarding a complete break from the Orientalist episteme is premised on the assumption that the Orientalist discourse was monolithic. This does more harm to Ray's project than to Orientalism. By flattening the Orientalist discourse, Raina tends to overlook the deeper difficulties, anxieties and shades within Ray's work. We need to understand the complex dialogue that Ray had with a range of Orientalist images of India.

To stress the essentialism of Orientalism, it is not necessary to essentialise Orientalism itself. Orientalism is a discipline- of encyclopaedic learning, and of imperial power- and yet on the other hand it also reflects an obsession with and a fantasy of the other. I have already discussed in my first chapter how the fascination with the natural world of the other produced a form of literature that went beyond imperial power and encyclopaedic documentation. Orientalism was thus always marked by this attempt to understand and appreciate this fascinating other. While its representation may ultimately appear hegemonic, it also represents a continuous dislocation of Euro-centrism. An attempt to appreciate the other continuously threw up the flaws of established European theories and notions.

Here I agree with Homi Bhabha who rejects the proposition that Orientalism was a straightforward representation of the Other. He suggests that Orientalism does not reflect a crude stereotyping as opposed to the complexity of the actual peoples being characterised, "...the colonial stereotype is a complex, ambivalent, contradictory, mode of representation, as anxious as it is assertive, and demands not only that we extend our critical and political objectives but that

[33] "The Young P. C. Ray ...", p. 14.

we change the object of analysis itself."[34] The Orientalist hegemony is thus always asserted, but is also always slipping, ceaselessly displaced, never complete.[35]

What I would like to stress is that Orientalism was fundamentally a fascination and an attempt at a sympathetic understanding towards the Other. This gave it a remarkable flexibility to absorb and shape challenges, even re-locate itself when necessary and thus strengthen its fundamental hegemonic position. Ray's work was a challenge to some of the categories of Orientalism was finally absorbed and synthesised into strengthening Orientalism's basic postulates. Bose unlike Ray, having accepted the predominant East/West divide never faced the complexity of the Orientalist discourse. Ray's work, however, failed to generate a 'crisis' within the Orientalist paradigm. It only helped in a re-location which was always intrinsic to that discourse.

Hindu Chemistry and the Orientalist Episteme

Let us at the very beginning focus on Ray's central thesis – contestation of the superiority and antiquity of Greek knowledge through a historical analysis of India's ancient civilization. Can this be seen as a clear break from the Orientalist tradition? From the early 19th century Orientalist texts in India have shown an increasing appreciation of India's scientific tradition. Along with a negative attitude towards Indian scientific knowledge there was a parallel trend of appreciating Indian past. This awareness led to voices of dissent and generated exciting debates.

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[34] Homi K. Bhabha "The other Question" *Screen*, Vol. 24, No. 6, 1983, p. 22.

[35] However, Bhabha's scheme of 'hybridity' raises some of its own problem. For one, it would tend to diffuse the question of colonial hegemony. If Orientialism was 'hybrid' then how can we explain its hegemonic characteristics? He does try to identify some dominant power relation and central object give within this 'hybrid' discourse. But at the same time this hybridity had the element of a degenerative force in forms of resistance against the colonial discourses. For an analysis of all this aspects of Bhabha's work see Robert Young *White Mythologies; Writing History and the West*, Routledge, London and New York, 1990, pp. 141-156. My understanding of the Orientalist discourse appreciates Bhabha's ideas of a fluid, amorphous discourse where both the coloniser and the colonised are implicated. I would like to show how through such an open-ended structure, the discourse could shape its dissent and discontent.

The early attention was on astronomy. From the 17th century French scientists, particularly Laubere, had started taking an interest in Indian astronomy. But a more serious study was done by M. Barley, a distinguished mathematician, contemporary of Laplace, LaGrange and D'Alembert, published his "History of Astronomy from its Origin to the establishment of the Alexandrine Schools" in 1775; in which he stoutly argued for the antiquity and excellence of Hindu Astronomy. He treated the subject in greater detail in 1787, in his "History of Indian Astronomy".[36] In the second volume of *Asiatic Research* Samuel Davis wrote on the "Astronomical Computations of the Hindus". He procured a copy of *Surya Sididhanata*, one of the most ancient Indian astronomical works and translated portions of it bearing upon the predictions of eclipses and other phenomena.[37] In his essay, "On the Antiquity of the Hindu Zodiac", William Jones sought to prove that the Indian Zodiac was not borrowed immediately or directly from the Greeks. He suggested that both the Greeks and Hindus had received the knowledge from an older nation, which first gave names to the luminaries of heavens.[38] Jones' work here reveals an important element of Orientalist literature which placed India and Greece at the same civilizational status. Rueben Burrow, another mathematician, had contested the superiority of European mathematics. He was the first to translate Indian works on algebra and arithmetic.[39] In an article "A Proof that the Hindus had the Binomial Theorem" Burrow produced evidences to show that the Hindus had a differential method similar to that of Newton. He claimed, "Hindus understood it (the Binomial Theory) in whole numbers to the full as well as Briggs, and much better than Pascal".[40] Burrow systematically, collected and translated Indian manuscripts on mathematics for an European audience.[41] Prof. Playfair of Edinburgh read a paper before the Royal Society where he showed how his earlier "Scepticism towards

[36] Bose, (P.N.) "Natural Sciences", *Centenary Review of the Asiatic Society of Bengal*, Calcutta, 1885, pp. 21-22.
[37] "Astronomical Compilation of the Hindu", *A. R.*, Vol. II, p.175-226.
[38] "On the Antiquity of the Hindu Zodiac", *A. R.*, vol. II ,p.227-240.
[39] Reuben Burrow, "A proof that the Hindu had the Binomial Theorem", *A. R.*, Vol. II, pp.388-395.
[40] *Ibid.*
[41] Bose (P. N.), "Natural Science", pp.21-22.

Indian mathematics had been converted into a conviction on its accuracy and reasoning".[42] This also initiated a debate between Bailey and Playfair on the one side and J. Bentley on the other regarding the antiquity and originality of Indian mathematics.[43]

The idea of Greece as the fountainhead of all rational knowledge was contested in Edward Stratchey's writings. He argued that the science of algebra went to Greece from India. Diophantus, the only scholar to talk of algebra in Greece, received the knowledge from "Some Alexandrine merchants trading with India ... or might have learned 'from Indians at Alexandria".[44] Orientalism implied a conflict with Hellenism. Civilizationally Greece symbolised the origin of European culture. Greece was the origin of its intellect, its science, the root of its myths. The Orientalists obsession with the 'Other', to understand, appreciate and celebrate its own culture engendered an encounter with Hellenism.

With Colebrook's work the debate on the antiquity of Indian scientific knowledge was intensified. Colebrook, a prominent figure among the Orientatists, was a Sanskrit scholar, a mathematician as well as the President of the Asiatic Society.[45] He published his "Indian and Arabian division of the Zodiac", where he maintained that the Arabs had adopted a division of the Zodiac familiar to the Hindus.[46] In the twelfth volume of the *Researches* he produced a treatise, "On the Notion of the Hindu Astronomers concerning the Precessions of the Equinoxes and Motion of the planets". Here he sought to corroborate what Bailey and Playfair were arguing about the authenticity of Indian mathematics and astronomy.[47]

With the publication of Colebrooke's treatise, the ongoing debate reached its peak. The question was whether Indian algebra was as old as Colebrooke and

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42 *Ibid.*, p. 28.
43 *Ibid.*, p. 24.
44 O. P. Kejariwal, *The Asiatic Society of Bengal and the Discovery of India's past, 1784 1838* OUP. Delhi, 1988, p. 113.
45 *Ibid.*, pp. 112-120.
46 *A.R.* Vol.IX, pp.323-376.
47 "On the Notion of the Hindu Astronomers Concerning the Recession of the Equinoxes and Motions of the Planets", *A. R.*, Vol. 12, p.211-252.

others held it to be, and whether it was of Indian origin. The opposition to Colebrooke came mainly from James Mill who in his book had criticised Colebrooke for advocating the antiquity of Indian Science.[48]Mill was criticised by Orientalists for his 'grossly prejudiced' position:

> From a writer so grossly prejudiced as Mr. M. (Mill) has shown himself to be against the Hindu, it would be vain to expect any impartial discussion ... This gentleman labours under another disqualification, namely his utter ignorance of the subject.. On mathematics' he says, I must speak superficially'. Pity it did not occur to him that he had the alternative of not speaking at all! [49]

A stark anti-Hindu position was not acceptable to the Orientalist writers: rather, in their appreciation of Orientalist philosophy, literature the opposite holds true. If the Orientalists had been originally enchanted by 'Orientalist' literature and poetry, 'Oriental' science was to be soon appreciated as well:

> We are not cleverer than the Hindus; our minds are not richer or larger than his. We cannot astonish him, as we astonish the barbarians, by putting before him ideas that he never dreamed of. He can match from his poetry our sublimest thought; even our science perhaps has few conceptions that are altogether novel to him.[50]

If Orientalists pre-figure Ray's anti-Hellenism, John Forbes Royle in the 1830s pre-empt Ray's views on medicine and chemistry. Forbes established *Charaka* as the earliest source of Indian medicinal studies.[51] According to him chemistry was one of the eight divisions in which the treatise of *Charaka* was divided. Arabs derived their knowledge of chemistry from the Indians. The Indo-Aryans, Royle argued, knew how to prepare muriatic, nitric and sulphuric acids, they were aware of the process of distillation and calcinatian:

> The number of metals which the Hindus were familiar with, and their acquaintance with the various processes of solution, evaporation, calculation, sublimation and distillation prove the extent their knowledge of Chemistry, and the high antiquity of some of the chemical

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[48] Kejariwal, *op. cit.*, pp. 113-114.
[49] *Ibid.*, p.114.
[50] Kumar, "The 'Cultures of Science", p. 197.
[51] Bose, (P. N.) *Hindu Civilization*, p. 17.

> arts, such as bleaching, dyeing, Calico- printing, tanning, soap and glass-making.[52]

Royle's arguments on the medicinal use of mercury and other chemical compounds are strikingly similar to those of Ray:

> The oxides of several metals as of copper, iron, lead, tin and zinc, they were acquainted with and used medicinally. Of lead, we find mention of both the red oxide and litharge. With sulphates of iron, copper, antimony, mercury, and arsenic, both reagar and orpiment, they have long been familiar. Among the salts of the metals, we find the sulphates of copper, of zinc, and of iron, and of the latter the red distinguished from the green: the diacetate of copper, and the carbonates of lead and of iron, are not only mentioned in the works but used medicinally.[53]

Other Orientalist studies on Indian knowledge of surgery claimed that Indians performed, lithotemy, extraction of dead foetus, paracentesis, thoraces and abdomen etc. Such studies also showed the great variety of instruments being used.[54]

Thus there were clearly two strands in the Orientalist understanding of Indian scientific knowledge. One strand represented by Levi, Haas, Goblet d'Alviella held that Indians learnt their science and mathematics from the Greeks via the Arabs. The second, expressed by Colebrook claimed a greater antiquity and authenticity of Indian knowledge systems. Both celebrated classical civilisations: the first strand, celebrated Greece, the second, classical India.

Ray's work can be located within this latter line of thought. Ray himself saw his project, not as a break from the Orientalist tradition, but as a continuation of the earlier studies on Indian mathematics and astronomy. His discussion of Vedic science was drawn almost fully from Colebrook,[55] and his insights into medicine and chemistry were informed by Royle. He himself made these links apparent in the preface of his first volume,

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[52] *Ibid.*, p. 18.
[53] *Ibid.*
[54] Wise "Commentary on the *Hindu system of Medicine*", p. 157, quoted in *Ibid.*, p. 19.
[55] Ray, *Hindu Chemistry*, Vol. I, pp. 1-23.

> Since the days of Sir W. Jones, Sanskrit literature in almost every department has been zealously ransacked by scholars, both Europeans and Indians. As the results of their labours we are now in possession of ample facts and data, which enable us to form some idea of the knowledge eof the Hindus of old in the fields of Philosophy and Mathematics including Astronomy, Arithmetic, Algebra, Trigonometry, and Geometry. Even medicine has received some share of attention... One branch has, however, until this time, remained entirely neglected namely, Chemistry. Indeed, it may be assumed that an account of its complex and technical nature repelled investigators.[56]

Ray had found in Max Muller a great supporter of his intellectual agenda. He showed how Max Muller had attacked the popular European prejudice regarding the superiority of Greece:[57]

> In some respects, and particularly in respect to the greatest things...., India has as much to teach us as Greece and Rome, nay, I should say more ...
> ...We in the West have done some good work too, and I do not write to depreciate the achievements of the Hellenic and Teutonic Minds. But I know that on some of the highest problems of human thought the East has shed more light than the West, and by and by, depend on it, the West will have to acknowledge it.[58]

More directly, Ray drew inspiration from the works of Berthelot and Kopp. After reading their work: "The idea firmly took hold of me that I must write a history of Hindu Chemistry modelled upon the examples before me".[59] Berthelot as a practising chemist and as a historian of chemistry appeared as a role model. Ray believed he could now do what scholars in India had not done yet.

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[56] Quoted in Ray, " *Life and Experiences,* p. 119. Elsewhere as well, he provided a similar rationale for his project,
It is to an illustrious roll of European Scholars beginning with Sir William Jones, Colebrooke, Princep, Lassen, Bournouff and Lsama de Koras that we are mainly indebted for bringing to light and giving prominence to, the priceless treasures embedded in Sanskrit, Pali and Tibetan literature. Hindu Chemistry, however, waited long and patiently for an interpret etc...
Ray, *Essays and Discourses by Dr. Prafulla Chandra Ray. With a Biographical Sketch and A Portrait,* G. A. Natesan and Co. Madras, 1918, p. 101.
[57] Ray, *Hindu Chemistry,* Vol. I, p. XLV
[58] *Ibid.,* pp. XLV- XLVI
[59] *Life and Experiences*, p. 117

However, we need to understand Ray's enthusiasm around chemistry. A chemist himself, Ray saw chemistry as the highest form of scientific knowledge. Ray argued that the knowledge of such an experimental science was the real test of critical aptitude, while mathematics could only show an innate love for the abstract.[60]

To Ray chemistry expressed and shaped the critical thinking of a civilization. Ray lived at a time of great euphoria, subsequent to the exciting new discoveries it had brought about in Europe from the last half of 19th century. Berthelot had prophesied that by 2000 A. D. all necessary articles of food would be prepared chemically by chemists from the very elements.[61] Ray shared this vision, when he said: "Chemistry is the science *par excellence* which at present determines the fate of nations and the assiduous pursuit of it has given Germany an enviable predominance in world politics."[62]

The euphoria around the scientific and industrial merit of chemistry had naturally inspired in Europe studies of its historical lineage. Berthelot's own study of Greek alchemy reflected such a development. Ray's project, too, has to be seen in that light, particularly because he drew his inspiration from the works of Berthelot, Kopp etc.

Now let us shift our focus to the nature and structure of *Hindu Chemistry*. The first volume of the book starts with a discussion on the alchemical ideas of the Vedas.[63] Next, it moves to the period of Susruta and Charaka, which is called the 'Ayurvedic Period'.[64] Then comes the pre-Tantric period from 800 to 1100 A. D. when Buddhist influences were being felt in Indian medicinal practices.[65] The Tantric period was from 1100 A.D. to 1300 A.D., when mercury was used for medicinal purposes.[66] This art found its fullest development in the Iatro-Chemical

[60] "The Pursuit of Chemistry in Ancient India", *Modern Review, 23(2), 1918*, p. 187.
[61] Raina, "The Young P. C. Ray", pp. 7-8.
[62] Ray, *Essays and Discourses*, p. 88.
[63] *Hindu Chemistry*, vol. I, pp. I –X.
[64] *Ibid.*, pp. XI – LIII and pp. 1- 54.
[65] *Ibid.*, pp. LIV – LXI and pp. 58 – 63.
[66] *Ibid.*, pp. LXII – LXXXIX and 64-75.

Period from 1300- 1850- A. D. This was the time of great Buddhist scholar Nagarjuna and the great Tantric texts like *Rasaratna Samuchaya.*[67] Ray's history ends with an analysis of the causes for the decline in scientific researches in India, particularly from the 13th century on wards.[68]

In the second volume Ray elaborated how Tantric practises were compatible with the scientific spirit.[69] Ray's discussion in the second volume curiously leaves out any discussion of the Islamic influences on Indian practices in the medieval period and his discussion of the centuries 1500 to 1600 A. D., titled "Modern period", discusses how, with a general stagnation of the science of Chemistry, the earlier arts were practised by lower caste people.[70]

Ray's project was thus to construct a history of classical Hindu Chemistry of India, to discover a glorious past. To that extent his work was characterised by the same Whiggism which tends to locate political wisdom, and identity of a society all in its *history.*[71] In writing a history of chemistry from the Vedic to the Early medieval, Ray was looking for the roots and legitimacy of modern chemistry particularly mercury in India's past. Post-Enlightenment scientific thought attempted to locate the origins and processes of evolution of social institutions, beliefs and knowledge systems. The essence of such a scientific history was to show a parallel evolution of human beings and institution. Proceeding from such assumptions Ray defined civilizations in terms of their antiquity: European civilization was Greek and Indian civilization was the product of ancient India. True to such a tradition, Ray searched for a 'pure' original Indian tradition, the true spirit of Indian knowledge. His search for a Hindu science was a pilgrimage to the 'Indian fountain head of learning'- untainted by outside influence: "The student of Hindu Chemistry, however, like a weary but devout pilgrim, must wind his way through intricate and thorny paths

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[67] *Ibid.*, pp. LC – CVI and 75- 151.
[68] *Ibid.*, pp. 190 –197.
[69] *Ibid.*, Vol. II, pp. 44-52.
[70] *Ibid.*, p. LXXVI.
[71] J. W. Burrow, *A Liberal Descent: Victorian Historians and the English part*, CUP. Cambridge, 1981. pp. 288- 298.

and feel ineffable joy at being able to approach the original fountain head undefiled.." [72]

To that extent his search was identical to the European search for the pure essence of Greece. But how did Ray, the devout pilgrim reach his 'fountainhead'? To understand this we have to take up the most important part of his book – the section on Tantrism and Alchemy.

P. C. Ray discovered the real elements of chemical research in the tantric engagement with mercury form 8th century on wards. In his writing, the Yoga doctrines of Patanjali paved the way for the origin of Tantric mysticism, associating itself with magic and alchemy.[73] This lineage could counter the claim that European alchemy, particularly that of Paracelsus, was of greater antiquity, "Some twelve centuries later, this phase in the stage of human progress found exponents in the soils of Europe".[74]

At the same time Ray sought to legitimise the Tantrics as honest seekers of truth.[75] He argued that their type of mystic ideas of nature characterised the early scientific spirit of Europe as well.[76]

This pilgrimage to the Tantric period was based on varied kinds of Sanskrit sources from different periods. Often they could not be revived in their original form and he had to depend a later copies and versions.

Among his sources, *Rasarnava* alone seems to have survived. Ray read one transcript of it at the Raghunatha Temple Library Kashmir, and the other at the Oriental M. S. S. Library, Madras. This source threw light on the chemical knowledge of the Hindus about 12th century A. D. The author of this text was,

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[72] Ray, *History of Hindu Chemistry, Vol. I, pp. LVI – LVII.*
[73] Ray, "The Tantrists, The Rosicrucians", p.237.
[74] *Ibid.*
[75] *Ibid.*, pp. 238-238.
[76] *Ibid.*, p. 238. It would be relevant to mention here that there were earlier attempts by Indians to compare Tantrism with Western scientific enquiry. Bhudev Mukherjee equated Tantrism with positivism. Social reform according to him was a return to pristine Hinduism, an attempt to control the forces of nature for man's well- being – which was essentially characterised by Tantrism. Forbes, *Positivism in Bengal, p. 129-30.*

however, unknown. *Rasarnava*, according to Ray, inspired several works of the latro-chemical period, notably the *Rasaratna Samuchhaya* (R.R.S.) and *Rasendra Chintamani.*[77] The *Rasarnava* borrowed copiously from Nagarjuna's *Rasaratnakara*. This last work could only be obtained in fragment from the Kashmir Library and Ray used it to examine the authenticity of R*asornava.*[78] Since the original *R.R.S* could not be found, Ray depended on the editions published at Puna, based upon a comparison of 13 manuscripts procured from different parts of South India. He also looked up a manuscript of *R.R.S.* in the library of Sanskrit College, Banaras, copied in Samvat 1850 (1793 A. D.). Another transcript that he checked was in the Kashmir Library. The Banaras and Kashmir manuscripts, according to Ray, agreed in all essentials but differed in places from the Puna edition.[79] *R.R.S.* was the central text for Ray's history as it was the only systematic treatise on materia medica and medicine. The materia medica here was "harmoniously blended with chemistry" which fulfilled the conditions of his 'latro-chemical' period.[80]

The history of chemical knowledge of the Tantric period was constructed out of the information culled from a variety of ancient sources. Ray said that he wrote *Hindu Chemistry* was written out of an attempt to "Compare and collate carefully the passages in MSS. of Rasaratnakara, Rasanarva and Rasaratna samuchchaya, in so far as they bear on chemistry and allied subjects, in this way several important lacunae have been filled up and many doubtful reading reassured".[81] Somewhere Ray's method appears so similar to the way an Orientalist worked. As Said has remarked, "There the Orientalist is required to *present* the Orient by a series of representative fragments, fragments republished, explicated, annotated, and surrounded with still more fragments."[82] Ray, much like Jones, depended on a Pandit to discover and identify the elements of

[77] Ray, *Hindu Chemistry, Vol. I*, p. LXXXIII
[78] *Ibid.*, p. LXXXIV.
[79] *Ibid.* p. LXXXVI.
[80] *Ibid.*
[81] *Ibid.* p. XXXIV.

[82] Said, *op. cit., p. 28.*

alchemical knowledge from mounds of different Sanskrit texts.

Through the construction of a systematic history of chemistry from various disjointed sources Ray was creating a *mythology of coherence* and a *mythology of doctrines*, both of which were the basic characteristics of a historicity that tends to shear elements of the past from their contexts and re-creates rationalist fictions of past heritage.[83] This type of history writing was a feature of the Orientalist tradition in which Ray's work was most firmly rooted.

Skinner shows how historians of ideas often impose a high degree of consistency on a whole corpus of work which might not be there if those sources were analysed separately on their own 'terms. So history becomes, "a history of fictions – of rationalist construct out of the thought processes of individuals not of plausible abridgements of these thought processes".[84] Closely connected with this was the *mythology of doctrines* which converts scattered or quite incidental remarks by a classical author into a "doctrine", as a theme close to the heart of the analyst.[85] What is overlooked here is the context within which the works were produced, "Any statement ... is inescapably the embodiment of a particular intention, on a particular occasion, addressed to the solution of particular problems, and thus specific to its situations in a way that it can only be naïve to try to transferred.."[86]

Ray's attempt to construct a coherent history of Indian alchemy from various fragmentary sources, spread over a period of 800 to 1600 A. D. suffered from the same estrangement of knowledge, being disembodied from its context,

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[83] These concepts are borrowed from Q. Skinner. See Skinner, J.G.A. Pockock and John Dunn. See Quentin Skinner, "Meaning and Understanding in the History of Ideas", *History and Theory*, Vol. 8, 1969, pp. 3-53' J. A. Dunn "*The identity of the History of Ideas*", *Philosophy*, 43, 1968' J. G. A. Pockock, "Languages and Their Implication: The transformation of the Study of Political Thought" *Politics, languages and Time : Essays as Political though and History*, London, 1972, p. 11. The concepts are basically developed by Skinner See p. 16 and pp. 7.-8.

[84] Dunn *op. cit., pp. 87-88.*

[85] Skinner, *op. cit.*, pp. 7-8.

[86] *Ibid.*, p. 50. While making these points one is aware of the problems of an extreme relativist position which these arguments may run into. An argument for a complete disjunction between past and present – that past is beyond conception of the Present defects the very purpose of history, i.e. to understand the past. But the important argument that comes out here is the need to locate idea of part within their social and cultural milieu. Otherwise, past ideas, particularly 'classical' ones are often assigned a universal characteristic, much too easily.

that characterised Europe's search for Greece. What came out was a museum, in the sense Andre Malraux uses it, of the knowledge of ancient chemistry.[87] This museumization and decontextualization was particularly characteristic to the Orientalist reconstruction of India's past because it always had to refer to Greece whether to contest its claim to primal knowledge or to corroborate it. Ray's description of the chemical knowledge of the Tantric and the Iatro-chemical periods is a case in point. Based primarily on *Rarsarnava* and *R.R.S* respectively it was a selective translation of only those parts of the text that dealt with Chemistry and often supplemented by other texts like Rasendrachintamani and Rasendrasarasamagrabha etc. For example, while desiccating the medieval use of orpiment of *RRS* Ray locates a 'more scientific' process in *Rasendrasarasamagraha* (p. 91). Similarly, *RRS's* descriptions of experiments with diamonds are substantiated with further ones from *Rasendrachintamani* (pp. 102-103). When the information on Galena, a sulphide coherent of lead appeared 'scanty' in *RRS,* Ray turns to Uday Chand Dutt's "Materia Medica of the Hindus" which was compiled from very different [as even later Ray admitted doubtful sources (p. 262)] sources (p. 94-95). Similarly on many other occasions the texts were corroborated, compared and the more scientific versions were extracted.

The attempt was to prepare an anthology of systematic, coherent and comprehensive scientific knowledge of chemistry in ancient India about minerals, metals, for a period of over five hundred years, from varied sources. I will show later that a focus on Ray's exclusions offers a very different reading of these texts.

India and Greece; The Contest for Antiquity

The politics of Ray's works was to contest the hegemony of Greece. He questioned the antiquity of Greek knowledge not its content. To that extent the book served not only to universalise what was known as Greek but also to

[87] Malraux, *The Voices of Silence*, Frogmore, Paladin Books, 1974.

decontextualise the texts that he read.

Ray identifies the claustrophobia of this obsession with Greece, but was trapped within it all the same. Criticising the European preoccupation with Greece, he showed how narrow that view could be: "...whenever the priority of the Hindus is unquestionable, an appeal is made to the theory of common origins and independent parallelism of growth."[88]

His own work operates with the same narrative form, if only to invert it. At the very beginning, the validity of Susruta's work is established through a reference to a Greek technical treatise of the 11th century A. D. .[89] Pointing out the strange similarities between the chapter on 'initiation' in *Charaka* and the Eides of Esculapius, he argued for two independent parallel ancient traditions. Not satisfied with that he asserted that the Hindus were actually ahead of the Greeks on the question of humoral pathology.[90] He sought to "settle for good" the "question of priority" by arguing that humoral pathology was known to Indians during the lifetime of Buddha, i.e. even before the birth of Hippocrates.[91]

On the question of Tantric alchemy where Ray was contesting Berthelot directly, the parallels with Europe were even more striking. Talking of the rise of Tantrism through an encounter of Vedic and aboriginal cultures, he was reminded of the relationship between the conflict of 'black art' and the Holy Church at the time that alchemy developed in Europe.[92] The historical parallelism was drawn even further. Just as the Byzantine Greeks carried the intellectual records to the Italian cities on being driven out by the Turks, the Buddhist refugees took their knowledge to the Deccan and Tibet escaping the rise of Brahminism and the coming of the Muslims.[93] The Deccan for Ray remained the safe depository of Hindu Chemistry because it was beyond the reach of the "inroads and ravages of

[88] Ray, *Hindu Chemistry Vol. I*, p. XLII
[89] *Ibid.*, p. XXVIII.
[90] *Ibid.*, pp. XXXIV 0 XXXV.
[91] *Ibid.*, p. XXXIX.
[92] *Ibid.*, p. LXV.
[93] *Ibid.*, Vol. II, p. XLVII.

the Muhammedans".[94]

While faced with the vagueness and confusion in certain Indian texts regarding the constitution of metals and its fate after calcination, Ray immediately turned to Europe, only to suggest that such confusion prevailed even there until the end of 17th century. He referred to the failures of Boyle's experiments to illustrate the point.[95] Thus systems of knowledge were not explained within the economy that they belonged to. Rather they were to be justified through a comparison with Europe.

Ray's project, however, was not just to compare, but to assert Indian superiority through the comparison. Whenever there was a similarity of knowledge in India and Europe, Ray was keen to show Indian superiority. The Indians, he claimed, had developed their chemistry before Europeans: "The knowledge of practical chemistry, prevalent in the 12th and 13th centuries A. D. and perhaps earlier, such as we are enabled to glean from Rasarnava and similar works, is distinctly in advance of that of the same period in Europe."[96] Paracelsus and Libertines of Europe at a later stage were to discover such qualities of metals.

Ray in fact inverted the Euro-centric logic to assert that Paracelsus got his ideas of using mercury in medicine from the East.[97] Ray developed a scheme to show that scientific knowledge travelled from India to Europe via the Arabs and not the other way round. In the first volume of *Hindu Chemistry* he devoted an entire chapter to illustrate how this reverse flow occurred.[98] In doing so, he depended on Orientalist works like Ainslie's *Lapra Arabium*, published in *Transactions of Royal Asiatic Society* in the 1820s and Macdonald's *History of Sanskrit Literature*.[99] Located closely as Ray's project was to these texts and their method of working, it swung between points, Europe and India.

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[94] *Ibid.*
[95] *Ibid.*, p. 51.
[96] *Ibid.*, Vol. I, p. XCVII
[97] *Ibid.*, p. CII.
[98] *Ibid.*, pp. CVII – CXXXII.
[99] *Ibid.*, p. CIV – CV and p. CXXX- CXXXI.

The ultimate instance of his view of Eastern superiority and total disregard towards context came when discussing the preparation of different caustic and mild alkalis in the *Susruta*, he argued that the evidence of this knowledge appears in Europe as late as 1755.

> Here we span two thousand years from the *Susruta*, to the remarkable discoveries of Joseph Black, who was a M. D. of Edinburgh. In his doctorate thesis (presented in 1755) he gave, for the first time in Europe, the scientific explanation of the difference between caustic and mild alkalis.
>
> This method you will look in vain in any European treatise before the 16th on the 17th century. The process as given in the *Susruta* is so scientific that it can be bodily transferred to any modern textbooks on chemistry...[100]

Ray travelled all of two thousand years and from India to Europe with remarkable ease. His project is full of such flights. The process of zinc extraction described in *Rasarnava* and *R.R.S.*, he argued could be quoted "almost verbatim in any treatise on modern chemistry."[101] Ray in his attempt to counter Europe, was building up his own 'Europe' in Indian soils and tradition. There are glimpses of a break in the narrative, of his realisation that Indian system had its own logic. But this logic is discovered when Greek knowledge could not be traced back to India. Its possibilities are not explored beyond that. Countering Dugald Stuart's evidences of similarities between Indian and Greek medical system and the suggestion that Indians learnt it from Greece, Ray argues:

> After all, we are afraid, too much has been made of the resemblance between the Greek and the Hindu theory and practice of medicine. The analogy is more superficial than real, and does not seem to bear a close examination. The Hindu system is based upon the three humours of the air, the bile and the phlegm, whilst that of the Greek is based upon four humours, namely, the blood, the bite, the water and the phlegm-a cardinal point of difference.[102]

Similarly questioning the idea that Indians benefited from the Greeks in astronomy he argued that the Greeks always functioned with seven metals and

[100] Ray, "Progress of Chemistry in Ancient India", p. 498.
[101] *Ibid.*, p. 499.
[102] *Hindu Chemistry*, Vol. I, pp. XLVI - XLVII.

seven planets, the Indians recognised only six metals. The only reference to seven metals in Indian texts was in the *Sarnagadnara* which he considered to be an aberration and inconsistent.[103]

Thus for a moment it appears that Ray was able to grasp the problems of historical parallelism, he was beginning to identify the distinctive elements of the theories of nature that developed within different spatio-temporal boundaries. But these never become central to Ray's project. To him they were useful as long as they established the originality of Indian knowledge. Even if equivalence and even superiority was established, the mythology was still overtly Greek. That post-Enlightenment myth of Greek knowledge was always projected as having universal validity. Ray now put forward the claim that Indians along with the Greeks produced this universal knowledge:

> The spiritual and thought-world has always transgressed all barriers of time and space. Kanada, Patanjali and Nagarjuna of India and Heraclitus, Empedocles and Plato and the rest- they all form a holy fraternity; aey, these prophets and orders of the intellect belonging to a "lofty and sequestered class", "the high-priest –hood of pure reason", the *Trismegisti*, the expounders of the principles of though from age to age.[104]

Ray's pre-occupation with Greece in many ways reflects the elements of the emerging nationalist historiography of his times. Ancient India became the classical age for the nationalists while the period between the ancient and modern was the age of medievalism. As the 19th century Englishmen claimed ancient Greece as his classical heritage so did the English educated Indian intelligentsia claimed 'Vedic Civilization'. This trend was approved by European historiography. A very influential text for the nationalist school was Elphinstone's *History of India (1841)* the most widely read British history of India. Elphinstone showed great sympathy for early Indian achievements in philosophy, astronomy and mathematical sciences, medicine, language, literature, fine arts and commerce. The other influence was *The History of India as Told by*

[103] *Ibid.*
[104] "The Tantrists, The Rosicrucians" *op. cit.*, pp. 238-239.

its Own Historians, by H. Elliot, edited and published after his death by John Dawson (1867-77) which particularly focussed on the Muslim tyranny in the medieval period.[105] As Partha Chatterjee has shown, in the second half of the 19th century European scholarship seemed to have agreed on the classicality of Hinduism. For some it was the in the Vedic Civilization, for others it was in the so-called Gupta age--from the fourth to the eleventh centuries – followed by the medieval decline.[106]

The task of writing a history of Indian science coalesced with a search for classicism in India's tradition. Thus Ray is unable to accept the possible diffusion of this knowledge in later periods. The introduction of the concept of Rahu to Indian astronomy thus amounted to its 'degeneration' from that classical Indian wisdom,

> By the 5th century A. D. we find that the beginning of a scientific astronomy had been laid. Varahmihira distinctly sets forth the doctrine of diurnal revolution of the earth on its axis. Again Varahmihira, Aryabhatta, Sriseva and Vishnuchandra offered the true explanation of the solar and lunar eclipses. But by and by, this scientific explanation came to be discarded. In compliance with the prejudices of the bigots an eighth planet, Rahu, was invented as the immediate cause of the eclipse. Astronomy thus slowly degenerated into astrology.[107]

Indian knowledge is considered scientific and acceptable as long as it conformed to the Greek framework. Any diversion from that was considered 'degeneration'.

A similar preoccupation with Greece is noticeable in another contemporary work on the history of Indian science, Benoy Kumar Sarkar's *Hindu Achievements in Exact Science.*[108] The main aim of the book, as stated by

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[105] Chatterjee, *Nation and its Fragments*, p. 100-101.
[106] *Ibid.*, p. 102.
[107] Ray, *Essays and Discourse*, p. 189.
[108] Benoy Kumar Sarkar, *Hindu Achievements in Exact Science, A Study in the History of Scientific Development*, Longmans, Green and Co., New York, Bombay Calcutta, 1918.For a good survey of the various contemporary works on history science see Michael Shortland's,"Foreign and Familiar Lands: Indian History and the History cf Science", *Studies in History of Medicine and Science*, Vol.2, New Series, 1994,pp.171-204.

Sarkar himself, was to compare the scientific ideas of various civilizations – Hindu, Greek, Chinese, Saracens.[109] The object was to establish the materialism of the East and stress its similarity with Greece.[110]

The book starts with a straightforward claim, the superiority and ingenuity of Indian scientific knowledge.

> Hindu intellect has thus independently appreciated the dignity of objective facts, devised the methods of observations and experiments elaborated the machinery of logical analysis and truth investigation, attacked the external universe as a system of secrets to be unravelled, and wrung out of nature the knowledge of which constitute of the foundation of science...[111]
> ...The claims of the Hindus to be regarded as pioneers of science and contributors to exact positive and material culture rest, therefore, in all respects on the same footing as those of the Greeks in quality quantity and variety.[112]

The inverse- Hellenism was expressed in these words,

> Much of the credit, however, is really due to the Hindus. Saracen mathematics, chemistry, and medicine were mostly direct borrowing from Hindu Masters. The Greek factor in Saracen culture is known to every modern scholar, the Hindus factor remains yet to be generally recognised. That recognition would at once establish India's contribution to Europe.[113]

Indian knowledge had the same universal, transcendental qualities that was characteristic of Grecian knowledge. Often they proved to be even better, "The 'pure' mathematics of the Hindus was, on the whole, not only in advance of that of the Greeks, but anticipated in some remarkable instances the European discovery of the sixteenth, seventeenth and eighteenth centuries."[114]

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[109] *Ibid.*, p. v.
[110] As he put it, "the student of comparative culture-history would find that the tendencies of the Oriental mind have not been essentially distinct from those of the Occident."*Ibid.* Although he talked of a comparison of various civilizations – his actual comparisons in the book were only with Greece.
[111] *Ibid.* p. 6..
[112] *Ibid.* p. 8.
[113] *Ibid.* p. 5.
[114] *Ibid.*, p. 4.

One outcome of such a project was the same 'Archeo-populism' that marked European writing on Greece.[115] Secondly: knowledge, particularly scientific knowledge of the past was endowed with 'timeless elements', 'dateless ideas' and universal applicability. Third: the argument produced a reverse-Hellenism: a celebration of Greece. They conformed to the principles of Hellinism while contesting its antiquity.

Decline and the Narrative Break

But somewhere this parallel narrative had to part ways. While Europe with its Greek heritage had engineered a scientific revolution, India had lost its way. For B. K. Sarkar the break was not major. To him, "this epoch of 'Superiority' needs to be analysed a little more closely".[116] Scientific laws by themselves did not bring about progress, it was with steam technology that the West surged ahead. For him it was in 1815, with the defeat of Napoleon that modernity was ushered into Europe. The difference between the East and the West was thus only of a mere 100 years, " a difference of one century, the 'wonderful century'".[117]

> Neither the laws of motion and gravitation (of the latter half of the seventeenth century), nor the births of the science of modern chemistry and electricity during the latter half of the eighteenth could or did produce the superiority in any significant sense. There was hardly any difference between Europe and Asia at the time of the French Revolution (1789). The real and only cause of parting of ways between the East and the west, nay, between the medieval and modern, was the discovery of steam, or rather its application to production or transportation. The steam engine affected an industrial revolution during the first three decades of the nineteenth century. It is this revolution which had ushered in the "modernism" of the modern world in social institutions, science, and philosophy, as well as brought about the supremacy of Euro-America over Asia.[118]

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[115] Ernest Gellner coins this usage, see his *Conditions of Liberty, Civil Society and its Rivals* Penguin Books. 1996 (1994)., p. 54. The point he is trying to make here is the tendency by modern civil societies of Europe to draw parallels between modern and ancient liberties of Rome and Greece.

[116] Sarkar (B. K.) *op. cit.,* p. 6..

[117] *Ibid.,* p. 7.

[118] *Ibid.,* pp. 6-7.

For Sarkar, the industrial logic of science was important. In his scheme, unlike that of Mahendralal Sircar, it was not the learning of science that could have the regenerative influence in India; industrialisation could release the forces of change. The full implication of this line of thought would be analysed in the next chapter.

In Ray's *Hindu Chemistry* the explanation for the absence of the scientific revolution had to be a major issue after having situated ancient India at par with ancient Europe.

Ray linked the decline of Indian scientific spirit to the increasing caste rigidities. His argument went as follows: with the Brahmanical revival against Buddhism, the caste system was established in a more rigid form. The *Manusmriti* and later *Puranas* tended to glorify the priestly class. This class, which was traditionally the carrier of scientific knowledge, now stopped being intellectually active.

> The Intellectual portion of the community being thus withdrawn from active participation in the arts, the *how* and *why* of phenomenon the co-ordination of cause and effect-were lost sight of-the spirit of enquiry gradually died and among a nation naturally prone to speculation and metaphysical subtleties and India for once bade adieu to experimental and inductive sciences. Her soil was rendered morally unfit for the birth of a Boyle, a Descartes or a Newton and her very name was all but expunged from the map of the scientific world.[119]

Thus science as a liberal pursuit could not survive under such a rigid and hierarchical, social system. Chemistry and surgery became "lost sciences to the Hindus".[120] In clear contrast to the European Renaissance of the 13th, 14th and 15th centuries , India gradually moved away from the 'rational' course.

> But in India the state of things were quite different. The Hindu nation had lain in a moribund condition for a thousand years or more ... Our ancestors lost the power of thinking for themselves and slavishly and blindly followed the injunction of the Sastras as interpreted by Raghunandan of Navadwip and his like. The caste systems had taken

[119] Ray, *Hindu Chemistry, Vol. I, p. 195.*
[120] *Ibid.*, p. 193.

firm root in Hindu society.'[121]

Thus Ray identifies the causes of the decline as internal to Indian society. The main culprits were the Brahmins who now enforced the rule of Sastras.[122] It is in this discussion of the social cause of the decline of scientific spirit that Dhruv Raina sees the essence of Ray's social history of science and his break from Orientalist historiography.

The merit of Ray's analysis was that he located the decline of Indian science in the social matrix of the country, and not in the more popular nationalist themes of the invasion of Muslims and the subsequent dark ages. The reason why Ray avoided such an analysis was because it would not have provided Ray with the tool to analyse India's complete failure. He found such elements in European middle ages as well but while Europe 'overcame' it, India continued to struggle. The problem thus had to be identified in something peculiar to Indian society. Caste provided that clue. However, in this Ray was not alone. P. C. Ray had depended on R. C. Dutt whose ideas ran in a similar line. In the times of Yajur Veda high castes were associated with various useful arts and sciences; however, as the caste system became increasingly rigid, all such knowledge perished.[123]

More importantly P. N. Bose in his *History of Hindu Civilization,* published before *Hindu Chemistry,* identified caste as responsible for the stagnation of Hindu intellect. According to him the "Hindu Civilization carried the germs of its decay within it".[124] Caste rigidities led to an isolation of the intellectual class from social realities. This put a stop to their study of material science, "Directly the caste-system prevented, in course of time, the spread of knowledge beyond a small privileged, hereditary class and indirectly led to the neglect of the physical science".[125] This was, to him, in sharp contrast to the west

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[121] *Life and Experience,* p. 148.
[122] *Essays and Discourses, p. 189.*
[123] *Hindu Chemistry,* Vol. I, p. 190.
[124] Bose, (P. N.) *Hindu Civilization,* Vol. 1, p.V.
[125] *Ibid.*

where people from different ranks of society had risen to contribute to the expansion of scientific theory.[126] Some years later, Nehru in his *Discovery of India,* found evidence of the decay in Indian society in the growing rigidity and exclusiveness of the Indian social structure as represented chiefly by the caste system.[127] This marked India's decline in all fields – intellectual, philosophical, political, technical etc. Thus caste had appeared in the nationalist historiography as a useful tool to understand the break in the narrative –India's deviation from the path of Europe.

In the colonial European thinking generally, caste as an institution characterised Indian society as radically different from the West. In the utilitarian thinking of Bentham and Mill it was identified as the key social institution within India which made it incapable of acquiring the virtues of modernity.[128]

Neeladri Bhattacharya has shown in the realms of legal discourse how the knowledge of Brahmin pundits was a matter of great suspicion to the European experts.[129] To the Benthamite radicals the interpretative, innovative legal versions of the Pundits amounted to deception and dishonesty. The Orientalist's fear of total dependence on Brahmin informants and of being misled by them made them more inclined to locate social norms in 'reliable texts'. This made them ignore the vibrant tradition of contemporary indigenous legal discourses and "freeze Sastric learning into old texts"[130] He also shows that in Sastric learning, the 17th and 18th centuries were highly creative. Even in 1820 a series of learned texts were produced. But none of these were consulted as a result of this suspicion of recent works.[131]

Here we find two strands, one sustaining the other, in the European attitude towards caste and knowledge. The first is the identification of caste as

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[126] *Ibid.,* p. VI.
[127] Cited in Chatterjee, *Nationalist Thought,* p. 135.
[128] Chatterjee, *Nation and its Fragments,* , p. 173.
[129] "Remaking custom : The discourse and Practice eof colonial codification", in R. Champakalakhsmi and S. Gopal (eds.)*Tradition, Dissent and ideology; Essays in Honour of Romila Thapar,* OUP. Delhi, 1996, pp. 27-32.
[130] *Ibid.,* p.30.
[131] *Ibid., fn.* 27.

anathema to modern liberal thinking. The other was the general distrust towards more contemporary creative works, generally produced by the Brahmins. It was these two lines of thought that informed Ray, Bose and Nehru's analysis of India's decline.

P. N. Bose conformed to this Orientalist distrust of recent learning traditions of Brahmins when he said, "Except two or three commentators, the Brahmans have not during the last seven centuries produced a single writer of note in any department of human knowledge. They have forgotten the principles of the mathematical and medical sciences in which their ancestors had acquired such distinction...."[132]

He sympathised fully with Jones, when the latter distrusted his Pundit informants,

> When a century ago. Sir William Jones, the founder of the Asiatic Society of Bengal, offered ample stipends to any Hindu astronomers who could name in Sanskrit all the constellations which he would point out and to any Hindu physician who could bring him all the plants mentioned in Sanskrit books, he was assured that no Pandit in India even pretended to possess the knowledge he required. [133]

The textual, uniform expectations of the European Orientalists were not satisfied by the more fluid, innovative contemporary traditions they were faced with in India. The ancient texts naturally appeared more reliable. The recent changes were seen as corruption, just as Ray saw the introduction of 'Rahu' in astronomy as an aberration, a superstition. In this point of view, these Brahmins, as a result of the caste rigidities, had lost contact with the material world and their power of inquiry.

How far does Ray's caste-centric scheme actually explain decline in scientific temper? Let us take up the case of Tantric alchemy, his most important topic. The rigidified caste structure does not by itself explain much because Tantric practices from the beginning had discarded caste norms. They flouted

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[132] Bose, (P. N.), *Hindu Civilization*, Vol. I, p. XXXV.
[133] *Ibid.*, p. XXXVI.

brahmanical regulation and included people from various castes.[134] Moreover, in Ray's scheme active research in Alchemy goes on till 1600. Caste rigidities as a social phenomenon had taken place earlier. Tantrism seemed to have weathered that.

However, Brahmanical revivalism did pose a real threat to Buddhism, which began to migrate to Deccan and Tibet.[135] Any way, the minimised Buddhist influence did not mean that Tantrism practise stagnated. Tantric practise continued throughout the medieval period and was very much a living tradition in the 19th century as well.[136] Recent researches show that the 'brahmanisation' of Tantrism actually helped it to remain a popular practice, while 'high' Tantrism became an increasingly esoteric, elite, mystic path and thus too complicated and refined for common people; the brahmanised Tantrism continued to be popular.[137] This group known as *Nath Siddhas* continued to offer concrete and relatively accessible worldly *power*. The Siddhas, famed as specialist technicians in the transmutation of base metals into gold and the transformation of mortal, ageing men into a perfected, immortal supermen, masters of natural processes, became supernatural power-brokers of medieval India. The Nath Siddha were often cast in the role of kingmakers, elevating untested boys to the throne throughout medieval South Asia, at times bringing down mighty tyrants.

The basic philosophy of tantric tradition developed and articulated itself numerously throughout these periods. Tantrism represents a philosophy of sacred sexuality, celebrating the body as the manifestation of the Divine. The tradition was summarised in the sixteenth century, in *Satcakranirupana*.[138]

John Woodroffe who has researched on Tantrism, emphasises that the basic tenet of Tantrism, is that matter, and therefore the body, is also a

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[134] Romila Thapar, *A History of India* Vol. I., Penguin p. 215.
[135] *Ibid.,* pp. 249-253.
[136] A very important exponent of Tantric thought in 19th century was Ramkrishna. For the Tantric influences on Ramkrishna see Kripal, *op. cit.,*
[137] David Gordon White, *The Alchemical Body : Siddha Traditions in Medieval India*, The University of Chicago Press, Chicago and London, 1996, p.7.
[138] Nasr, *Order of Nature*, p. 242.

manifestation of *Sakti* (power) of the feminine aspect of Divine reality. The masculine force could be activated only by cosmic union with the feminine. Thus central to Tantrism was a celebration of the body, and of feminine sexuality or Sakti.[139] It was as a part of this celebration of the body that various bodily practises became popular within it. Tantric alchemy too has been seen in that light. The claim was that taking of mercury along with certain chemicals, served the body and prolonged life. This notion became particularly popular in the 13th century.[140]

However, in the tantric philosophy, supernatural powers and bodily immortality, cannot, be realised through alchemy alone. It consisted of three complimentary approaches to the attainment of such a goal: The erotico-mystical, (involving sexual fluids generated from a female body because the lineage nectar was supposed to have been transmitted through female sexual emission), the *hathayogic* practices (meditation and asceticism designed to effect reunion with the universal spirit) and the alchemical. These approaches are complementary in as much as they all play on the correspondence between human and divine vital fluids (*rasas*) and in the transformation of the body through all three of these complementary techniques. Thus the tantric alchemical definition of rasas is different from and more ambitious than that of the main stream Indian medical traditions. In the latter, *rasayana* is the regeneration or restoration of the vital bodily fluids (*rasas*), to a youthful state of health and virility. In tantric philosophy the *rasa* in question is mercury which substitutes human bodily fluids and thereby assigns immortality to the human body of flesh and blood.[141]

Ray, due to his own involvement in the research of mercury and for his fascination for Berthelot's work on Paracelsus, had looked only for the traces of mercury in Indian tradition in these Tantric practices. But his pre-occupation with the narrative of Greece blinded him to the meaning of the essence of Tantric engagement with mercury. His project was to write a history of Indian alchemy,

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139 John Woodroffe, *The World on Power*, Ganesh, Madras, 1974. P. 161.
140 Thapar, *op. cit.*, p. 262.
141 White, *Op.cit.*, p.303.

parallel and similar to that of Berthelot's European one. It was this pre-occupation with the European narrative that prevented his history of chemistry to be located within the appropriate social and cultural milieu. This pre-occupation also meant that he had to tell a story of decline. Thus the fuller history of the Tantric alchemical beliefs appeared irrelevant to him. An analysis of these trends would have provided the answer as to why and how the chemical practice of mercury started, what was the economy and world of belief within which it figured and why, if at all, it went out of practice.

I would like to illustrate one instance of how Ray sought to divorce chemistry from Tantrism. His discussion of chemical knowledge of the Iatro-chemical period from *RRS* comes to the section where the Sanskrit text discusses the Tantric rites of initiation into the secrets of mercury as in Book VI. This section is dealt in only one and half pages. Ray translates a few paragraphs of such rites and then stops abruptly, "Here follows an account of certain disgusting and obscene rites burrowed from Rasarnava and other Tantric Works" (p. 116). Then he skips the whole description of 20 pages to come to the discussion on chemical apparatus. Although he observed that such 'obscene' rites were part of other Tantric texts as well, they had no significance for Ray.[142]

In a recent reading of *Rasarnava* the complicated picture of Tantric alchemy becomes apparent. It stresses the compatibility of the three complimentary processes mentioned above. It points out the significance of worshipping Siva in both his mercurial and phallic forms. The structure of the laboratory reveals the theological stance of *Rasarnava's* author : The *Rasalinga*, composed of mercury was installed at the heart with other lesser goddesses on the outside. The text describes how the tantric alchemist tempers his Tantrism and sublimates certain erotico-mystical practices with *hathayogic* and laboratory techniques. The sublimation of male and female sexual essences into mineral essences, which were to be manipulated by the alchemists, formed a vital part of such practices. The text describes how a female 'laboratory assistant' (especially

[142] Ray's *Hindu Chemistry*, Vol. I, pp. 115-116.

her sexual and menstrual fluids) is crucial to the alchemists' practices.[143] It is possible to guess which parts of such texts Ray found 'disgusting ' and 'obscene' and thus to be excluded.

It would be relevant here to discuss a later version of P. C. Ray's book. In an abridged version of Hindu chemistry, edited by P. Ray, the attempt was to erase the link of alchemy and Tantrism with ancient chemistry. In P. Ray's version of the decline of the scientific spirit of India, the alchemical traditions of P. C. Ray's work were disowned and the de-contextualisation of scientific thought was complete. It saw alchemy as the 'wrong way' that the course of chemistry in India had taken and was the cause of its decline, "As a matter of fact, science in India proceeded in a wrong way with the pursuit of alchemy and occultism, and in consequence came to stagnation and decay in the Middle ages".[144]

Thus the interesting, radical possibilities of Ray's project were overlooked in its later version . Scientific knowledge was further exorcised of its pluralistic orientations and meanings . The history of science of India had become part of a western rationalist tradition, completely sanitised and secularised.

In Ray's scheme of decline we find a re-articulation of the dominant Orientalist contrast between a 'sleeping', 'slumbering' Orient, and an active Occident:

> The history of the past thousand years tells us that the Hindu have been living all these years in stupefaction like so many opium-eaters. The world's history, however, reveals the fact that when a nation is reduced to this state of intellectual stagnation, it loses the capacity to think for itself and places unshakeable faith in the past. It forgets that the world moves – the progress is the law of nature- that a nation, if it means to survive, must alter its manners and social customs according to the exigencies of time[145]

[143] White, *Op.cit*, pp.172-177.
[144] P. Ray (ed.) *History of Chemistry in Ancient and Medieval India incorporating the History of Hindu Chemistry by Prafulla Chandra Ray,* Calcutta 1956, p. 241.
[145] Ray, "The Bengali Brain and its Misuse, *Discourses, op. cit.,* p. 184, Ray further adds, "For nearly a thousand years the Hindu nation has been on good as dead", *Ibid.,* p. 181.

Thus enters the logic of social action, of reforms, of changing Indian systems to conform to the western notions of progress. Here also is located the justification for his own political and social activism. But what is more interesting in this description is that Ray feels quite close to James Mill's account of India. His description of the moral and intellectual demise of India, borrows richly from Mill, the same scholar against whom Colebrook and others were fervently arguing in favour of an Indian scientific acumen. Ray while demonstrating how Indians have become metaphysical and speculative, said,

> To the Hindu the material is but an illusion and Sankara as an exponent of the Vedanta Philosophy is unsparing in his criticism and denunciation of the atomic theory as propounded in the Vaiseshika's philosophy ridiculing the author of the system itself as 'Kanada' or atom eater.. No wonder Mill should write. "The Hindu boys display marvellous precocity in appreciating a metaphysical proposition which would hopelessly puzzle an English lad".[146]

Ray thus accepted the Orientalist divide between the East and the West, even if it contradicted his earlier questioning of those very categories: "Indian culture has been from time immemorial of a peculiar cast and mould. It will not be quite wrong to say that the Hindus are pre-eminently a metaphysical nation."[147]

This is how Ray comes back within the realms of the dominant Orientalist scholarship. The question of a Hindu mind becomes acceptable to him. He agrees with M. Seven when the latter says, "The Hindu mind is very religious and very speculative; as an obstinate guardian of traditions, it is singularly insensible to the joys of action and to the solicitation of material progress."[148]

His dissent with certain Orientalist characterisations was ultimately synthesised within the scholarship. His dissent, since it followed the Euro- centric and Orientalist path had to ultimately return to confirm both the problematic and

[146] "Pursuit of Chemistry in Bengal" *Ibid.,*, p. 38.
[147] "Presidential Address", *Proceedings op. cit.,* p. 1.
[148] *Ibid.,*, p. II

the thematic of such a discourse. From that position British rule naturally appeared to be a progressive, regenerative force, "Indian mind lay in this condition till the beginning of the nineteenth century when new conditions of life arose out of the establishment of British rule. This contact with the West brought in new ideas and new modes of thought in Indian life."[149]

Till now we have analysed how Ray sought to locate chemistry in the Indian past. A task still remains. In this last section we will analyse Ray's definition of attitude towards science as it emerges from his *Hindu Chemistry*. This will be crucial to our ongoing discussion on the emergence of a 'nationalist' redefinition of Science.

Chemistry and the History of Chemistry

I would begin this section with one crucial question. How did Ray's discovery of Hindu Chemistry affect his own chemical researches?

Dhruv Raina establishes certain linkages. In 1895 Ray commenced his researches afresh on the problem of assigning a place to mercury and some of the heavy metals in the periodic table. It was around the same time that Ray traced the place of mercury and mercury based compounds in Indian alchemy and argued for their anteriority over European usage. Based on this link Raina explored a Bachelardian possibility in Ray's *Hindu Chemistry*. The Bachelardian framework stressed that history of science can have a positive impact on scientific thought through a mutual interaction between the two. Thus Raina analyses Ray's work in terms of these two intertwining strands – one as a chemist assigning mercury a place in the periodic table; the other was establishing the therauptic practices of alchemy in India's past.[150]

The links that Raina established between these two projects of Ray do not answer the problem I am addressing here. The question remains, how did Ray's study of the history of chemistry inform his research in chemistry? Or more

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[149] *Ibid.*, p. II.
[150] Raina, "Young P. C. Ray", pp. 27-28.

generally, what new light did his history of science throw on modern science?

It is a significant fact that in Ray's career his dual involvement with mercury went together. His involvement with the research of mercury explains partially his engagement with mercury in the past. History has always been a reflection of a historian's contemporary concerns. They shape the question he asks and the facts he selects. The other influence on his history of mercury was Berthelot's work on Paracelsus' discovery of properties of mercury.

However, although his scientific researches might have influenced his historical studies, the two projects remained compartmentalised. After completing the first volume of *Hindu Chemistry,* he felt the need to come back to researches in chemistry. That return would also ensure his return from the past to the 'modern world' - the 'liberal' world of modern science, the world of his own,

> The preparation of the first volume of the History entailed such hard and continuous labour that it did not leave me much time to pursuer my studies in modern chemistry. I was buried in my researches into the chemical knowledge of the Hindus of old and therefore losing touch with the modern world. On the completion of my first volume I therefore paused in my antiquarian studies and put aside altogether for a few years my completion of the promised second volume of *Hindu chemistry* as I had now to catch up and be *en courant* with modern chemical literature.[151]

Thus to Ray *Hindu Chemistry* was an 'antiquarian' project. His scientific researches were insulated from it. His historical studies had no implications for the practice of his science. The same attitude is reflected in his statement a few years later, after the completion of the second volume: "Once more chemistry claimed me as her own by which I mean that I was at liberty to devote my attention and energy exclusively to the project of my first love."[152]

This disjunction can be grasped better if we analyse Ray's general attitude towards science and its past. To him the real science was that which had emerged after the Scientific Revolution of Europe. The scientific knowledge before that,

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[151] Ray "Life and Experiences", p. 122.
[152] *Ibid.*, p. 164.

although universal, merely had the status of proto-science: "Modern Chemistry, by which I mean *Scientific Chemistry,* is only of yesterday's origin. It may be said to date from the time of Lavoisier, who, as you all know, was one of the earliest victims of the fanatical outburst which followed in the wake of the French Revolution."[153] (emphasis mine)

By this very definition, history of science prior to 18th century only had a political and historical value to him. *Hindu Chemistry* had nothing to suggest to modern chemistry, the two were different stories. Ray's nationalist project of writing a Hindu chemistry remained a contest for greater antiquity. The tone of the work was historical and not scientific and it did not produce any redefinition of science.

Thus Ray sympathised completely with modern Western science, with its temporal, secular, mechanical characteristics. Unlike Sircar or Bose, he did not perceive any moral crisis within it. Sircar, if we remember, believed Indians could add a new dimension to contemporary science. To Ray that possibility never arose. His difference from Sircar becomes clear when he defined science in Indian tradition, "Not that the cultivation of physical science was entirely neglected in India's ancient days, but it proceeded as an adjunct to the study of metaphysics and religion...."[154] Spirituality and religion, which were essential to Sircar's ideas of science had become an 'adjunct' to Ray. True science was that which was free from any metaphysical and spiritual connotations.

Dhruv Raina in a recent article has rightly pointed out the lack of sociological perspective in Indian writings of the history of science.[155] The relation between science and history have not been effectively analysed. He takes the case of the *Indian Journal of History of Science* which has failed to give a professional shape to the discipline. Except for the discipline of mathematics,

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[153] "Pursuit of Chemistry in Bengal", *Discourses,* p. 34.
[154] "Presidential Address", *Proceedings,* p. 1.
[155] Raina, "Historiographic Concerns underlying *Indian Journal of the History of Science*" A Bibliometric Inference", *Economic and Political Weekly* Vol. XXXIII, No. 8, February, 21, 1988, pp. 407- 414.

the field suffers from a lack of depth and diversity. Even in the history of mathematics the sociology of mathematics has not evolved. History of science is never taken seriously within scientific studies. The history of science in India thus remains a chronicle of scientific truths and reason based on a mobilisation of textual and artefactual evidence.[156]

To my mind Ray's *Hindu Chemistry* holds some of the clues to such a development of history of science in India. Ray's work enjoyed a great status in both nationalist historiography as well as history of science. It was *the* nationalist text on the subject. Subsequent works have often drawn inspiration from it. It laid the framework within which most of the latter works were written. Indian histories of science generally located a period of vitality in ancient India, followed by a period for decline. More importantly that history had to be parallel to and similar to that of Greece of Europe-- the knowledge of nature even in ancient period was universal. This in effect also put little emphasis on the sociological context of scientific knowledge. Knowledge could be abstracted from its context and social matrix.

Moreover, since Ray's *Hindu Chemistry* was not a critical analysis of the content of science itself, it soon lost meaning for the scientific community. History of science came to be valued for its antiquarian, nationalist aspects. Ray's project was a perfectly normal science activity in the Kuhnian sense, where anticipated conclusions were achieved in new ways. Not having raised any serious questions about the practise of science, it was bound to become amateurish and even ornamental for the scientific community. A typical example of a work inspired by Ray's *Hindu Chemistry* was that by K. C. V. Iyer who published Ray's Commemoration Volume.[157] He continued Ray's project of

[156] *Ibid.*, pp. 411-413.

[157] K. C. Viraraghava Iyer, "The Study of Alchemy", in *Acharya Ray Commemoration Volume*, Calcutta, 1932, pp. 460- 467. These modern rationalistic attitudes in the discussion of tradition of history of science of found in many cases. While discussing the ancient Indian medicine, in *Science and Culture*, the writer pointed out, "....True, there have crept in, during the passage of centruies, many things with doubtful utility and questionable value, but it may be confidently oped that if passed through the scientific machine, the useless things will be completely eliminated", "Ancient Indian Medicine and Modern Indian Research", *Science and Culture* , Vol. III, No. 3, Sept. 1937, p.150.

Alchemy and discovered more traces of them in Tamil Saivite and Tantric tradition. He analysed various *Sittars* (in Sanskrit Siddhas, Tamil Saivite texts) to show how they were familiar with alchemy, yoga and medicine. He is pre-occupied, predictably, in stressing the antiquity of these evidences. However, no attempt was made to locate these texts within the Saivite and Tantric philosophies which structured them. My intention here is not to hold Ray's project responsible for all the problems that later works suffered from. I am merely trying to show how his work, with the monumental status that it had attained, provided the framework for later works.

However, *Hindu Chemistry* was only one of Ray's many activities. His nationalism led to other commitments and other responsibilities. Science never figured so centrally in Ray's nationalism as it did to Sircar or Bose. It was probably because of this that he did not perceive the various moral, intellectual and cultural crises of colonialism within science, as they did. For them science was nationalism, and thus had to bear all the contradictions and crises that their struggle against colonialism produced. To Ray, his field of struggle was wider, and the manifestation of the crises he faced could take place elsewhere. At the height of the Non-co-operation movement Ray declared, "Science can afford to wait but Swaraj Cannot".[158] Here his idol was Stanslao Cannizzaro who on the eve of 1848 had shut his laboratory and joined the revolt. Ray's struggle against colonialism was manifested in a much more active social participation. He was fond of saying that he would leave his test tube to attend the call of the country.[159] In that activism, science would have its role to play. That part of his nationalist involvement with science we will study in the next chapter.

But with Ray, the nationalist involvement marked a disenchantment with the Romantic spirit of science which had marked the works of Sircar and Bose. Utilitarian science had a strong appeal for him. This was the second such disenchantment that we have seen in modern Indian history of science, the other having been with Thomas Holland. Utilitarian science legitimised itself, in Ray's

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[158] Ray, "*Life and Experience*, p. 228.
[159] "P. C. Ray – The Man and the Scientist", *Science and Culture* Vol.,III,No.3, Sept. 1937, p.158.

world view. To him the dilemmas of introducing western science in India had become irrelevant,

> It is scarcely necessary now to enter into an elaborate *apologia* for the cultivation of our own science. Even the man in the street realises that the battles which are being daily fought and the new surprises sprung upon the wondering public in connection with this the greatest war since the creation of the world have had their researches in the laboratories of chemists.[160]

Modern science held many promises for him. Not only of a regeneration of Indian minds, but of ushering a new civilization, a new future. Against such a rationale the possibilities of his antiquarian studies had to be limited.

[160] "Pursuit of Chemistry in Bengal", *Discourses*, p. 45.

CHAPTER - 7

Visions of Industrialism

Nationalism was not restricted to a search for self - identity. It promised a new political, social and economic order as well. To that extent it necessitated an articulation of a vision of the future. Science, with its progressive connotations in a 19th century world occupied a crucial position in the Indian nationalist search for a new future. This was the second project that western science initiated within Indian nationalism, the first being the attempts to locate and legitimize western science within the cultural traditions of India.

But were they completely distinct projects, with very different concerns and motivations? Or did one inform and enrich the other? If related, what was the nature of such a relationship? The answers to these questions, in many ways, deepens are general understanding of nationalist discourse on science. This chapter would seek to gradually unfold the complex nature of those answers.

To begin with, obviously somewhere the search for legitimacy of science in Indian tradition and the search for a future engineered by that science are inseparably linked. Mahendralal Sircar's project was indeed to ensure a new, self - reliant, mature, adult Indian nation. His engagement with the Eastern mind was to ensure a firm basis to that future. At a general level of course, visions of the future are articulated themselves in terms of the past or tradition. It is through a particular reading of the tradition that the utopia is located in the future. However, an ideology of disjunction with the past or tradition is inherent in the utopia. Often a utopia creates a past and then disowns it as it articulates new possibilities for the future with new choices to be made in the present [1]. Sircar was of course arguing for a 'new' India combining the best of the Eastern and the Western

[1] Ashis Nandi makes this point. See his "Evaluating Utopias: Consideration for a dialogue of Cultures and Faiths", in *Tradition, Tyranny and Utopias, Essays in the Politics of Awareness*, Delhi, DUP, 1987, pp 12 - 13.

world. Besides, there are certain visions, which did not even necessitate a dialogue with tradition. The Indian League, which opposed Sircar's plans, believed that a new industrial India could emerge through practical lessons and training in science and technology.

The history of the Dawn and the subsequent National Council for Education (NCE) movements reveals many of the complexities of this relationship. The two were the first attempts to articulate an indigenous notion of industrialization and education premised on the techniques of western science and technology. The Swadeshi movement was itself the first significant attempt to produce a critique of colonialism with a re-assessment of the traditions and the cultures of the country. On the political front it marked the divergence of colonial and nationalist interests. On the economic front it urged for a boycott of foreign goods and a development of indigenous industrial base. On the cultural front it attempted to replace the 'alienating' western education by an education enriched by the indigenous culture. The Dawn and the NCE, thus attempted to initiate a dialogue between the 'alien' and the 'indigenous' in order to usher in a new 'dawn'.

The Dawn Society and its journal, which was first published in the last decades of the 19th century, was one of the earliest platforms to discuss the possibilities of an indigenous industrialism.

Dawn reflected a larger contemporary nationalist industrialism, which was heavily influenced by the European romanticist tradition. In the 19th century the greatest critics of the Industrial Revolution in Europe were Carlyle, Ruskin and Morris. They projected a primeval longing for a harmonious pre-industrial community.[2] The Russian Slavophiles, European Theosophists, the leaders of the Irish Literary Revival and the members of the Arts and Crafts Movements together shared this opposition to western rationality, industrial society and academic illusionism.

[2] Partha Mitter, *Art and Nationalism in Colonial India, 1850 - 1922, Occidental Orientation,* C.U.P., 1994, p 243.

To these romanticists, Asia had a particular appeal. In these non-industrialised societies they hoped to find the paradise that was lost to them in Europe. As Partha Mitter has argued, this naturally led to a search and subsequent glorification of the 'spiritual' traditions of these countries. At the same time there was this realisation that western industrialism was destroying that paradise in Asia which they felt needed to be preserved. As early as 1800 Colebrook, an Orientalist, described in detail how the Indian handloom was being destroyed by the western industries. He gave a call to preserve the tradition of *Charkha* against this encroachment.[3] Thus the romanticists could also sympathise identify with the nationalist struggles in these countries which they interpreted as a resistance by a non- - industrial world to the industrial ones. The nationalists also found in these romanticists a great ally to help counter European hegemony. They adopted and stressed their spiritual identity to challenge the accusations of material inferiority.[4]

European romanticism had reached Indian shores through various routes. It had simultaneously forged links with the nationalist struggles. Helena Petronna Blavatsky, who was the founder of Theosophy, the crusade against western materialism, set up the Society's headquarters near Madras. Her theosophical successor Annie Besant became an Indian nationalist. The Irish Revival leaders joined hands with the Theosophists. Yeat's friend Johnstone went to India. Sister Nivedita, an Irish woman introduced Vivekananda to themes of romanticism.[5]

The person who influenced the question of Indian industrialism was Ernest Blinfeld Havell, a follower of Morris. A utopian critic of industrialism, Havell gave a sharp edge to the *Swadeshi* ideology, citing the spirituality of Indian art as the antithesis of European industrialism.[6] Havell pleaded for a return to the pre - industrial mode of production, making a strong case for Indian handicrafts. The influence of Morrisian ideas on Havell is apparent. Like Morris,

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[3] Ray, "Gospel of Charkha", p. 361 - 362
[4] Mitter, *op.cit.*, p.244.
[5] *Ibid.*
[6] *Ibid.*, p.246.

he thought that machines enslaved western society. Machines had not improved craftsmanship, merely reduced the prices of products. A non- - industrial society like India could escape such a fate by remaining true to its artisanal modes of production. Havell believed that India could improve its existing technology without succumbing to the evils of large-scale industrialism.[7] Many of these romanticist ideas converged in the Dawn movement. Nivedita and Coomaraswamy worked closely with the Dawn Society. Havell wrote for *The Dawn*.[8] In a world witnessing rapid strides in industrialisation in Europe, Dawn was attempting a difficult task. It was trying to initiate an Indian discourse of industrialisation through a critique of European industrialism. In the first decade of the 20th century, the *Dawn* consistently sought to institute a critical assessment of tradition and modernity.[9] S.C. Mukherjee, who expressed his reservations concerning modern science and industry, best articulated the moral connotation of its industrialism. He called for the abolition of the capitalistic mode of competition and hoarding of wealth. It was this mode of industrialism that exploited and impoverished the world. Thus Mukherjee's major concern was to develop modern 'science - based' industries, without the evils of western industrialism. Mukherjee critiqued the modern factory system for its poor hygiene conditions for labourers, the slave - like treatment of the labourers by the capitalists, the mechanical nature of the work, and because it often catered only to the rich providing luxuries.[10] The alternative mode was developed on the principles of small-scale industries, by placing the artisans at the core of the production system. Mukherjee's ideas thus reflected Havell's qualified critique of the machine, which was not opposed to machines per se but to large-scale industrialisation. Mukherjee's scheme, needed that the artisan be enlightened by

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[7] *Ibid.*, p.249.
[8] *Ibid.*, p.252.
[9] Dhruv Raina and S. Irfan Habib, "The unfolding of an engagement: *'The Dawn'* on Science, technical education and industrialisation: India, 1896 - 1912", *Studies in History*, Vol. 9, no. 1, 1993.
[10] *Ibid.* , pp 107 - 112. There were others who criticized the factory system for its lack of aesthetics. While handicraft was creative, the mill was merely imitative and repetitive. Samarendra Nath Gupta, "The Place of Art in Indian Industry", *Modern Review*, 15(4), April, 1914, pp.459-62.

the new knowledge of western science and technology and then continue to function in his own mode of production. The theoretical knowledge to be imparted to the artisans was to be applied mechanics, steam technology, analytical chemistry.[11] Mukherjee also felt a need for a new general education system which was to remain committed to the morality of this industrial system. It was as a part of this realisation that the NCE movement was initiated.

The NCE or Jateeya Siksha Parishad, initiated a new scientific culture through further dialogue between tradition and modernity. The nationalist scientific and technical education was to be supplemented by literary studies. The knowledge of science was to be complemented by the "knowledge of the country, its Literature, History and Philosophy and incorporating with the best oriental ideas of life and thought the best assimilable ideals of the West".[12] Significantly in its medical courses, the Ayurvedic and the Hakim system were to be included.[13] Thus the education policy of NCE reflected the other effort on the part of the Dawn to initiate an alternative industrial culture in India. This was sanctioned by the romanticists. In the pages of *The Dawn*, romanticists like Birdwood had consistently given a call to revive the literary, artistic and philosophical traditions of India.[14]

It was through this dual course - a critique of European industrialism and an alternative science - education culture that the Dawn sought to initiate its discourse on Indian industrialism. However, though the critique of industrialism remained popular to Indian nationalism for some time to come, this educational plan soon ran into trouble. This scheme was soon to be contested by some scientists and engineers who questioned the need for this literary supplement to science education. In their view, science and technological training must drop the cultural and moral components. The disagreement finally took the shape of a split in the movement in 1906. The group led by Mukherjee, including men like

[11] Raina and Habib, "The Unfolding of Engagement", pp.113-114.
[12] *The Dawn Magazine* (Calcutta), March, 1906, Part III, p. 107.
[13] *Ibid*
[14] Mitter, *op.cit*, p.252.

Gooroo Das Banerjee, Hirendra Nath Dutt, Asutosh Choudhury, S. C. Mallick, Brajendra Kishore Roy Choudhury, and others, stood for the multidimensional system of technical education. In 1906 they started the Bengal National College as a model institution under NCE. The rival group headed by Tarak Nath Palit, Bhupendra Nath Bose, Narendra Nath Ghose, Nilratan Sarkar, and Manindra Chandra Nandi - formed a second organisation in the same year to impart pure technical education. It was named the Society for the Promotion of Technical Education (SPTE). It formed its own institution, the Bengal Technical Institute under the SPTE.[15]

The debate was not so much about the nature of the industrial future as it was on the path to it. One suggestion was for a sympathetic and romantic attitude towards what was understood as 'tradition', and the other was to dealing the two attempts to build an industrial future solely on modern systems of knowledge. An important aspect of the general Dawn movement, as pointed out by Raina and Habib was that industrialisation was still very much a 'moral' agenda. But even within such moral agenda this attempt to drop the cultural and literary component was significant. At one level it was an early attempt to secularise industrial training. Much of our engagement in this chapter will show how this first influenced the larger industrial question.

However, contest within NCE between the camps was yet to be over. In 1910 an amalgamation between the two camps took place. The SPTE was merged with the Bengal National College to cater unitedly to the increasing demands on Indian national education and industrialisation.[16] But how were their differences resolved? In the course of time, the literary - technical education scheme proved to be a more difficult path. Very few students favoured it given the choice for pure technical training. The literary studies appeared to be an unnecessary appendage to the science studies. By 1916 - 17, very few students attended the

[15] *Dawn*, October, 1909, Part III, pp.101-104.
[16] Haridas Mukherjee and Uma Mukherjee, *The Origins of the National Education Movement*, Jadavpur University, 1957, p. 173

combination of literary and scientific studies in the Bengal National College as a result of which the college ceased to exist. The Bengal Technical Institute continued to thrive and became a mainstream training institute.[17] It is in this same tradition that the Indian Institute of Science (IISc Bangalore) set up by the Tata should be seen. Tata wanted to set up a research unit which would give an active impulse to research, to criticism, and thus provide self-reliance in scientific research to Indians. A pioneer in modern industries in India, J. N. Tata looked at the institute to provide the basis for the technological and industrial regeneration of India.[18] As in the NCE, the consensus there to was that priority should be given to scientific and technical subjects, with philosophical and educational subjects being generally ignored.[19]

Thus science as is evident from the teaching of it, had already successfully dropped the cultural and moral connotations in this movement. It had crystallised for itself the secular, insulated identities of a superior form of knowledge. It would be pertinent here to remember that the Swadeshi movement had ultimately rejected S.C. Mukherjee's alternative industrialism based on the artisan and had sought to replicate western industrialisation if only on a minor scale.[20]

However, the question of an Indian future based on science and technology was not resolved here. The search was marked with many more issues in the coming years as the nationalist reaches its different phases. It would be important to examine some of the important reservations expressed by Indian scientists regarding an industrial future. Such a study would show how the colonial reality as well the 'tradition' of India always posed a serious question mark over industrialising the country. Moreover these dilemmas sometimes

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[17] Aparna Basu, "National Education in Bengal", paper presented in the conference on 'Rethinking Indian Education: National Education Philosophy and its Contemporary Relevance', 26 - 27 February, 1996, *Educational Records Research Unit*, School of Social Sciences, JNU, New Delhi - 110067. p. 249.

[18] B. V. Subbarayappa, *In Pursuit of Excellence: A History of Indian Institute of Science*, Tata MacGraw Hill, 1992 pp. 20 - 27 .

[19] *Ibid.*, p.35.

[20] See A.K.Coomaraswamy's critique of the Swadeshi industrialism in Viswanathan, *Organising for Science*, pp. 39 - 40.

necessitated a fresh dialogue with what were identified as Indian tradition, which seem to counter the industrial culture. In the next section I would like to take up the case of two prominent scientists - P.N.Bose Nath Bose and P.C. Ray.

P.N. Bose, Development Dilemmas

The eminent geologist P.N. Bose was one of those few Indian scientists who were engaged in writing a detailed history of India's past. It was from his historical analysis that he produced a clear critique of colonialism and subsequently of western civilization.

P.N.Bose had gone to England on a Gilchrist Scholarship in 1874 and had specialised in geology at the University of London and the Royal School of Mines. In England he participated in political movements particularly against the government. The India Office annoyed by his political work tried to get rid of him by granting him a job in the GSI.[21]

P.N. Bose began his writings on ancient Indian civilization and the colonial regime started around the last decades of 19th century. It was at the same time that Dadabhai Naoroji and R.C. Dutt were developing their own critique of the colonial rule. He shared with them criticism of the colonial revenue policy, railways, and foreign trade.[22] But the geologist was to go beyond this economic nationalism of the early Congress movement. He articulated a thorough critique of colonialism and industrialism as well.

To P.N. Bose colonial rule was unacceptable because of it was ultimately alien. This was most evident in its bureaucracy which sought to rule the country but did not ever identify with it.

> Any form of bureaucracy which determines and execute what is good for its subjects without consulting their wishes and taking their help, without in fact, closely associating them with it, is not likely to succeed in its purpose. The failure becomes greater in its purpose. The failure

[21] J.C. Bagal, *Pramatha Nath Bose*, Calcutta, 1955, pp. 32 - 34.

[22] Pramatha Nath Bose, *A History of Hindu Civilization, Vol III, Intellectual Condition* 1896, Asian Publication Services, 1975, pp. xxix - xxxviii.

> becomes greater and more certain when the bureaucracy is a foreign one with a civilization entirely different from that of the people.[23]

He located the civilizational difference between India and Britain, somewhat predictably in the former's spiritualism and the latter's materialism.[24] However, his main thesis was that such incompatibility left little room for any sympathy between the two. To P.N. Bose difference breeds antagonism: "The tendency of every civilized nation is to depreciate every other civilization which is different from their own. The greater the difference the greater the depreciation".[25] Thus the British posed a greater threat to India than its Muslim rulers whose cultural similarities made the Hindus more "*en rapport* with their Mohamedan rulers than they are with the British rulers".[26]

But P.N. Bose's argument was not limited to the thesis of a civilizational difference. His anti - colonialism shared the romanticist rebellion against industrialism. His anti-colonialism thus drew strength from his anti-industrialism. In 1901, in a brilliant essay, "An Eastern view of Western Progress", P.N. Bose raised a vital question, "After the close of this remarkable century of brilliant inventions it may not be profitless to pause for a moment and inquire how they have affected the well being especially of the teeming inarticulate millions outside the pole of Western Civilization, who constitute the greater portions of the mankind".[27] The answer to this question for P.N.Bose was not hard to seek, "To a large section of the Orientals, however, the benefit is of a highly questionable character".[28] This was because modern colonialism had robbed these people from their possessions more ruthlessly and systematically.

> It is true, in former times; herds of barbarians, like those of Central Europe occasionally committed serious depredations. But the depletion of weaker people accomplished by the nations of modern Europe is none

[23] *Ibid.*, p. xxxix
[24] *Ibid.*, p.xxxxii.
[25] *Ibid.*, p.xxxxiii.
[26] *Ibid.*, pxxxxiv.
[27] Bose, (P.N.), "An Eastern View of Western Progress", *Essays and Lectures on the Industrial Development of India, and Other Indian Subjects*, W. Newsman, Calcutta, 1906, p. 231.
[28] *Ibid.*, p. 232.

> the less serious, because it is effected more slowly with *civilized weapons*. These weapons are non the less dangerous because they are *not seen*, and are wielded none the less effectively, because they are wielded by civilized and knowing people, pleading the inexorable necessity of the sacrifice of weaker people for the cosmic progress of the stronger.[29] (Emphasis mine)

What were these 'civilized weapons' the 'unseen' modes of this 'slow' exploitation. To P.N. Bose they were European Capitalism and Industrialism - "Capitalism, which leads to Mammonism, is probably the greatest curse of modern civilization".[30] The real content of western civilizing mission was capitalistic exploitation. It bred a form of regime in the colonies where all norms were violated. Where western liberalism was reduced to a grotesque parody of itself,

> Markets must be opened up and controlled for the produce of the gigantic mills and factories of the West, outlets must be found for the Western enterprise - the whole world must be converted into a happy hunting ground of adventurers and certainly not over - scrupulous Western capitalists. Despotism has joined hands with Republicanism, Liberalism with Conservatism, and Protestantism with Catholicism in the cause of Western expansion and Western domination in Eastern climes. Nations which were once foremost in promoting liberty and equality are now busiest in forging chains of thralldom for the helpless of Asia and Africa.[31]

Bose thought that science had to bear its share of moral guilt for this aggressive exploitation:

> Western civilization is based upon Natural Science, as the Eastern is upon Mental and Moral sciences; and if I had any choice between the two, I would unhesitatingly decide in the favour of the latter. The practical applications of natural science have wrought incalculable mischief especially to the people outside the pale of Western civilization; and in my opinion they on the whole have proved rather a curse than a blessing to humanity. It is steam and electricity, and the numerous infernal compounds invented by Chemistry, which enables the greater powers of the West to deprive the weaker people of the world of their independence and to exploit them and enslave them. The weak

[29] Bose, (P.N.), *Hindu Civilization*, vol.III, pp.Lxi - Lxii.
[30] "A Plea for Patriotic Movement", *Essays and Lectures*, p. 38.
[31] "An Eastern View....", p. 271

have been more or less exploited by the strong in all ages and all over the globe, *but never so scientifically, so universally and so relentlessly.*[32] (Emphasis mine)

Thus P.N. Bose reiterated the similar moral concerns regarding the practical application of materialist science that were once voiced by Sircar and Lafont. But unlike them he had linked such apprehensions to a sharp critique of colonialism,

> Natural science on its theoretical side has done a most commendable work. But the good thus conferred is confined to a comparatively insignificant fraction of humanity and is far outweighed by the evils wrought by the practical application of Physics and Chemistry. It is said that Archemedes was half ashamed of those wonderful innovations of his which were the admiration of his age. If modern science were more actuated by this ancient spirit, if it had not lent its aid so largely to material progress, and had kept more within the bounds of intellectual culture and ethical development, we would have almost unqualified praise for it. But its mechanical application, which from (sic.) such a fertile them (sic.) for exuberant jubilation in the West, arouse in us only feelings of anxiety and apprehensions.[33]

The negative applications of science were possible because the western scientists had successfully insulated their laboratories from their political conscience. Thus even the most liberal scientists were ultimately serving capitalism through their laboratories,

> The same physicist or chemist who will in his study or on the platform anathematise the capitalists for their iniquitous conduct, will, perhaps, in his laboratory invent some machinery or discover some compound which will feed and fatten the capitalists. It is like adding fuel to the fire while bemoaning its destructive effects.[34]

What was required was a new political conscience not enfeebled at the altar before science before science with courage enough to develop a new scientific attitude. In arguing so P.N. Bose had preempted the essence of J.D. Bernal's discussions on social functions of science.

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32 " A Plea for a Patriotic Movement", p. 41.

33 "An Eastern View....", pp. 271 - 272.

34 *Ibid.*, p 240.

The negative impact of science, was not limited to its practical technical uses. It also produced a ruthless and competitive culture in the West with Darwinism at its core. P.N.Bose, thus produced the second critique of Darwin in the nationalist discourse on science, in a brilliant piece in 1901. He argued that the problem was in the acceptance of Darwinism as a doctrine of human conduct and not merely as a hypothesis, which was what it had been:

> The immoral tendencies of the material development promoted by the practical application of Western Science have been deepened and strengthened by the theory of the "survival of the fittest", which of late has obtained such prominence in Western thought. Instead of being looked upon as a mere hypothesis to account for the genesis of specific forms, it has come also to be regarded, though most illogically, as if it were a doctrine of conformity with which man should live and should behave towards his fellow man.[35]

With this rejection of Darwinism, P.N.Bose questioned the entire evolutionism on which modern society had premised itself. He thought that such a competitive outlook was the cause of impoverishment of its moral ethics,

> But all the same, western society is so deeply imbibed with the evolutional, which has come to be synonymous with the gladiatorial view of life, that its estimation of moral qualities is becoming more and more dependent on the measures of cosmic success to which they may contribute.[36]

It was such a 'gladiatorialism' that had reduced the relationships between the nations as much as between human beings into one of utter disrespect and brute force, "the ultimate question between every two nations, even more than between every two human beings still is in highly expressive though somewhat exaggerated language of Carlyle: 'Canst I kill thee, or canst thou kill me?'"[37]

P.N.Bose explained colonialism in the light of this moral degradation of the west. He felt that it had destroyed the oriental paradise - a world of contentment and simple moralities,

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[35] *Ibid.*, p 264.
[36] *Ibid.*, pp 264 - 265.
[37] *Hindu Civilization*, p. xxxxiv.

> Ours was a very well ordered community: unaffected by ambition, contended with his last, ignorant of everything but his own calling - everybody was happy in his own sphere. He had plenty to eat, and had a large share of comfort also. The struggle of existence and the restlessness and discontent which are the inevitable consequences of each struggle were then unknown... But the good old times have passed away. We may sigh from them but they will never return.[38]

In his imagination colonialism meant the end of innocence for the Orient. That imaginary oriental paradise was lost, never to be found again. Thus to him it was this Western morality which had impoverished Asia and Africa, not the often cited factor like population rise.

> Western scientists are always dinning into our ears that the increase of population is the main, if not the sole, cause of the starvation, misery and ultimately the extinction of a large portion of it. A doctrine more mischievous in its effect or less founded in fact could hardly be conceived. The world has existed for thousand of years, and the pressure of population has never been too much for it... There was room enough and to spare in America, Australia and Africa for European colonisation, without exterminating or enthralling the simple and, in not a few cases, confiding aborigines; if the Europeans had been less actuated by the unquenchable thirst for material aggrandisement.[39]

In rejecting such an explanation, P.N.Bose rejected the 'development' discourse. In a few years thence the Indian scientific community would see population rise and lack of industries as the root causes of Indian poverty. Upon such premises the future development of India would be planned. But in P.N.Bose's worldview, the colonial experience was yet raw and bitter.

After this detailed study of P.N.Bose's understanding of India's colonial situation, we come to the question of his suggestion for the choices before it. Since the paradise was lost how put India now survive in this 'aggressive' 'competitive' world? Faced with the powerful forces of this industrialism he saw the inevitability of India's adoption of it:

[38] "Industrial Development of India", Presidential Address at the Bengal Industrial Conference, 1891, *Essays and Lectures*, p. 89.
[39] "An Eastern View....", p. 260.

.... capitalism is increasing at a tremendously rapid pace just like militarism - the evils of which are quite plain and as vehemently denounced; and we must move on with the time or perish, even though such a progress may clash with our own long and fondly cherished moral ideals.[40]

P.N.Bose confirmed that the future of India was in capitalism and industrialism only. If we focus on P.N.Bose the scientist and his personal work we can identify and appreciate the choices he made himself. As a geologist in the late 19th and early 20th century he was attached to a science which had made a most crucial contribution towards the industrialisation of Europe and the resource exploitation of the colonies. In his own work he had initiated the most gigantic step towards Indian industrialisation. His role was crucial in persuading Jamshedji Tata to establish the largest heavy industry in colonial India - TISCO.[41] For all his critique of the moral standards of modern industrialism he could not offer an alternative. He could not even articulate an alternative mode of industrial structure like S.C. Mukherjee. Being a geologist and a nationalist in a colonial industrial world had somewhere confined his choices for the future.

As a geologist seeking to develop India's mineral resource Bose had accepted the basic thrust of Baconian science-that of man's mastery over nature. This illustrates P.N. Bose's dual relationship with western rationality and science. In spite of his critique of the imperialist, materialist industrialism based on science, P.N. Bose shared the Victorian regard for science as a secular symbol of harnessing nature. In his historical writings on Hindu civilization, he had always deplored the 'speculative' 'metaphysical' and 'literary' nature of traditional Indian thought.[42] He even ridiculed the modern Indian education standards that did not provide an awareness towards the material world and particularly natural resources,

.... ask our graduates where coal and petroleum are to be found in India? Under what conditions can they be worked to profit? How is iron

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[40] "A Plea for a Patriotic Movement", p. 38.
[41] Vinay Bahl, "The Emergence of Large - scale Steel industries in India" p. 451.
[42] See Bose *History of Hindu Civilization*, Vol.III, p.I; pp.24-35.

> smelted? How can soap be manufactured from indigenous materials? - Not one in a thousand will be able to give anything like a satisfactory answer. Many there are who will intelligently discuss abstruse question of philosophy; who will make apt quotation from Shakespeare, Milton and a host of other poets, who have mastered English history better than many Englishmen; but few there are who know anything about the vast resources of their country, and how they can be utilised and developed.[43]

So P.N. Bose wanted a new material culture for modern India. At the same time he was hopeful that adoption would not lead to the European materialism which he despised. Such a process, in P.N. Bose's mind could be engineered by divorcing 'imperialism' from science,

> They (The Indians) need not feel any compunction of conscience in devoting themselves heart and soul not to the study of the practical application of Natural Science. For, the objective in their case is not, and never will be, Imperial expansion, but the harmless exploitation of the resources of their own country....[44]

Thus to the geologist, the industrialisation of India could be achieved by the 'harmless, exploitation of the resources. In arguing for an alternative large-scale industrialism he also rejected the Morrisian alternative. He found Havell's plan for an "artistic application of mechanical science" towards a regeneration of cottage industry unacceptable.[45] He found it too romantic to believe that cottage industries would drive foreign goods away from the market, "or even to make a serious impression on it."[46] His formula was a combination of two,

> Let every step that it is possible to take to be taken to secure the development of handloom industry. But, at the same time, there should be no abatement of the efforts which are being made for the expansion of the mill-industries.[47]

At the same time, P.N. Bose refused to surrender completely to the morality of that industrialism, whose evils had always tormented him. In his

[43] "Industrial Development of India", pp.10-11.
[44] "A Plea for a Patriotic Movement", p.42.
[45] The Possibility of Hand Loom Weaving in India", *Essays and Lectures* , p.57.
[46] *Ibid.*
[47] *Ibid.*

vision the industrialisation of the Orient was a step in challenging European industrialism. It would ultimately curb the aggressive tendencies of the west. The East could not do so in its present servile status, only by accepting modern European technique and by becoming independent could it counter the West effectively,

> If these people make a vigorous, well concerted effort to develop their resources on western methods, and supply their own wants, their markets would cease to be exploited in the way they now are by the western manufacturers, and their lands would cease to be happy hunting ground of Western enterprise. Western imperialism, would thus die a natural and peaceful death, at least in its present highly objectionable militant form...[48]

It could even lead to the other extreme- the relative decline of the heavy industrial civilization in the west- as he hoped, "Europe will then revert, at least partially, to the happy old times of cottage industry."[49]

Thus P.N.Bose ultimately dreamt of a new industrial culture in a different world order. To that extent it was a revolutionary image of the future, "That is a revolution so wholesome and far - reaching in the interest of both of the East and the West- that it is well worth a mighty effort on the part of the Orientals."[50] Here India would not only find its own identity, but would make a great contribution to general humanity. If Sircar had advocated the adoption of western science for a new moral world, P.N.Bose did the same for industries and here lies the significance of P.N. Bose's ideas. It is true that his visions of future ultimately took refuge in western science and industrialism. But he dreamt of industrialism in a new moral world order.

Let us now focus on another Indian scientist who had made significant contribution towards these visions of a modern India- P.C. Ray.

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[48] "Industrial Development by Indian Enterprise", Lectures delivered in Calcutta by July 1906.,*Essays and Lectures*, p. 31.
[49] "The Possibilities of Handloom Weaving" , p. 58.
[50] "Industrial Development by Indian Enterprise", p. 31.

P.C. Ray; from Chemical Industries to Charkha

The most fascinating aspect of P.C. Ray's career was the blend of various shades of identities. He was chemist in a world where chemistry was revolutionising heavy industries in Europe, particularly in Germany, then as a Gandhian he advocated Charkha, a cottage industry for the Indian cause and again he was one of the foremost industrial entrepreneurs of the Swadeshi era and a pioneer in this regard as a scientists. To this extent his career and life engendered the various trajectories of ideas and commitments that Indian nationalism had articulated.

Ray's entrepreneurial activities began quite early, in the 1890s. While teaching at the Presidency College he had wondered how the natural products of Bengal could be used to feed its poor people. He thought of industrial production of necessary items with the help of scientific knowledge. His inspiration was in his reading of the history of industrialisation of Europe, where "industry and scientific pursuits have gone hand-in hand, both have advanced *pari passu*, the one helping the other-.....The history of the gigantic progress of industry achieved in Europe and America is a history of the triumphs of researchers in the laboratory."[51] Europe had also shown how necessity was the mother of invention, how particular situations of distress had thrown up new areas of scientific discoveries and industrial progress. Germany had developed its indigenous modes of producing nitric acid having suffered from the blockade of the first World War. During the Continental blockade France had learnt how to produce sugar and soda on its own.[52] It was time, Ray felt, India did something similar with the help of its own scientific men. It was in this direction that he established the Bengal Chemical and Pharmaceutical Works in 1893.

His first attempt at producing citric acid from lemon juice had to be dropped as it was economically not viable. Ray soon realised that pharmaceutical

[51] P.C. Ray, "Bengal Chemical and Pharmaceutical Works - Its Origin" in *Life and Experiences of a Bengali Chemist*, p. 92.

[52] "Industry Precedes Technological Institute - The Great Illusions - Technology before Industries - The Cart before the Horse" in *Life and Experiences*, pp. 316 - 317.

preparations had a more ready market. He examined the Calcutta drugstores to find out about the quantities of drugs imported from Britain.[53]

But in pharmaceuticals, Ray was treading on lesser-known grounds of technical knowledge as a chemist. In his earlier sojourn to England he had found that pharmaceutical preparations were closely guarded secrets. He thus, started from the basics, by reading books on British pharmaceutical preparations, texts like *Pharmaceutical Journal, Chemist and Druggist,* Cooley's *Cyclopedia of Recipe* etc.[54] He solved the problem of procuring and producing locally some of the basic ingredients like Sulfuric acid and phosphates of soda. Having done this he found that most of the British pharmaceutical drugs could be produced without much difficulty. He bottled these drugs in second hand jars procured from local *bikriwallas.*[55]

Customers gradually accepted his products. Amulya Charan Bose, one of his assistants in the project began a vigorous campaigning among doctors. Soon physicians like Nilratan Sarkar and Suresh Prasad Sarvadhikar began to prescribe his medicines.[56] Amulya Charan added another dimension to Ray's Works. He encouraged Ray to interests himself in the preparation of *Kabiraji* medicines. Amulya had already consulted several *Kavirajas* and collected from them the formulae and recipes of ayurvedic preparations such as *Kalmegh, Vasak* etc. This was a great success as they were easy to prepare in a small workshop and had a large market.[57]

Gradually by 1900 the firm was converted into a limited liability company. A plot of land measuring about 13 acres was secured in the suburbs of Calcutta to expand its operation to a bigger scale. The sulfuric acid plant installed at Panihati was probably largest of its kind in India then. By the 1930s Bengal

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[53] "Bengal Chemical and Pharmaceutical Works", pp. 92 - 93
[54] *Ibid.*, pp. 94 - 95 and p. 103.
[55] *Ibid.*, p. 99.
[56] *Ibid.*, p. 104.
[57] *Ibid.*

Chemical and Pharmaceutical Works employed 2000 workers and their net assets amounted to half - a - crore of rupees.[58]

The Bengal Chemical and Pharmaceutical Works, was one of the first conscious attempts to replicate the success of European science - based industries on Indian soil. The attempt was, as Ray had put it, to bring science and industry "*pari - passu*". While building up the Works, Ray had always attributed his pioneering role to those instances of personal zeal and innovation, that marked the European enterprises.

> If one studies the history of progress of technical arts and scientific inventions in Europe, he will find solitary individuals working at a disadvantage and labouring under immense initial difficulties, giving to the world the result of their indefatigable zeal and devotion, which have revolutionised the industrial world....[59]

The marriage of science and industry had always fascinated the Bengali chemist. Chemistry particularly, he noted, had revolutionised industry in Germany and England. He showed how the foundation of the Imperial Chemical Industries in England had led to a large scale harnessing of chemical knowledge for industrial requirements. But in India, the once superior Damascus blades had deteriorated in quality as scientific input had dried up. Thus he concluded, "In Europe on the other hand, where science has been harnessed to the service of Industry, miracles have been worked in metallurgical processes"[60] Ray's Works was his demonstration to his countrymen that such miracles could be achieved in this country.

At another level his Bengal Chemical was a challenge to the Bengali *bhadralok* who hitherto had despised industrial or business entrepreneurial activities. In the second part of his article "Bengal - the Milch Cow" he produced a strong critique of the Bengali fascination for 'Clerkdom' and the consequent

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[58] *Ibid.*, p. 111.
[59] *Ibid.*, p. 96.
[60] "Industry Precedes Technological Institute", pp. 329 - 330.

exploitation of its resources by Marwari and Gujarati traders.[61] Ray found none of the required qualities necessary for an industrial future among his Bengali countrymen. The Bengali lacked the spirit of enterprise, business instinct as well as industrial habits like - hard work, dutifulness and punctuality. But the greatest obstacle, according to Ray, was the modern university education system to which the Bengali had taken to closely. Such an education rarely prepared the youth for the practical arts of trade and commerce. Even a bachelor of commerce could only hope to secure a petty job in a Marwari or Bhatia firm as a correspondence clerk. The science courses taught very little about the practical aspects of industry. He showed how inapt such education could prove to be for the purposes of industrial enterprise,

> The Bengali graduates in Science (M.Sc.'s) will recapitulate all the physical properties of aluminium, namely ductility, tensility, conductivity, as also their chemical properties. But the Bhatia knows nothing of these and yet makes fortune from the uses of metal.[62]

Even the more technical training had little value in commercial enterprises. Ray demonstrated the case of technical knowledge in geology and mining and its applicability in the mineral industries -

> Among the Indians the Marwaris and Cutchies are in the forefront. They know nothing of geology and mineralogy; but all the same they are always on the lookout as prospectors. They have secured large tracts of mining leases and also properties of coal and mica - mines, which they work on their own account. The brilliant Bengali graduate, with his high sounding Indian foreign diplomas in Mining, Engineering and Geology, thinks himself fortunate if he can secure a job under them.[63]

On this issue a consensus seemed to be emerging among other contemporary Bengali entrepreneurs and industry men. Jogesh Chandra Mukherjee, a successful entrepreneur, wrote,

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[61] "Bengal - The Milch Cow (Contd.) The Failure of the Bengalis and the Economic Conquest of Bengal by Non - Bengalis", *Life and Experiences*, pp.440 - 501.
[62] *Ibid.*, p. 452
[63] *Ibid.*

> Schools and colleges are not the places to learn trade and business; There one may learn the underlying principles, including political economy and book - keeping, but everywhere in the world one must begin on and humble scale and go through the rough and tumble of life, courting failures if necessary, which are the real precursors of success. But the Bengali is indolent and easy going, he fights shy of initial difficulties and risks with the result that he has been slowly but surely elbowed out by the plucky and adventurous non- - Bengalis.[64]

Rajsekhar Bose, the famous Bengali satirist who was a chemist in the Bengal Chemicals drew a socio - historical account of the situation. Historically, he argued, the Bengali middle class had comprised only of the upper caste who had a natural aversion towards trading and commercial activities. The modern western education had only strengthened the prejudice turning the Bengali youth generally towards clerkship and governmental services.[65] What was required was a cultural transformation - where trading and industrial activities were entrusted with greater prestige. Moreover, the Bengali must cease to exaggerate the value of university education and plunge into the world of business and trading and industry, "The young men should realise that although it is good to know how to produce a commodity, it is very often more profitable to know how to sell it".[66] Similarly, B.M. Das, tannery expert in the National Tannery and Government Tanning Research Institute discussed how schools and colleges did not develop an industrial culture. It had to be acquired in the real life of business.[67]

At one level, this was part of the nationalist critique of colonial education being too 'literary'. At another this was a critique of the predominant conceptions of science/technology - industry relationship in the country both among the Indian and their British bureaucrats. Ray had realized a vital point - that science did not produce industries, it only assisted it - and it was often the industrial base which encouraged scientific investigations: That is why the Bengali though

[64] *Ibid.*, p. 492
[65] *Ibid.*, p. 493
[66] *Ibid.*, p. 496.
[67] *Ibid.*, pp. 489 - 491.

equipped with scientific knowledge had failed to produce industries, "In every country, industrial progress has preceded progress in science and technology".[68]

Ray was thus extremely critical of the nationalist attention towards technical institutes and education. To him the hope that such institutes would produce industries amounted to "putting the cart before the horse". In his note to the Indian Industrial Commission of 1916 - 18 he criticized the suggestion that a Chemist Services Committee be formed . To him it reflected the absurd and fantastic notions that were entertained in this country regarding the capability of a technical institute. Ray further attacked the nationalist attitude which held that industries could be developed through changes in education system. He ridiculed the idea that once literary education was replaced with technical education, "industries will spring up magically all around".[69] He discarded M. Visweswara's passionate plea for the creation of a Technological University for Indian industrialisation as a "great illusion".[70] His experiences in Europe had suggested something else,

> I have visited the *Technische Hochschule* at Charlottenburg (Berlin) as also its counterparts in Zurich and Manchester and I should be the last person to minimise the importance of similar institutions. But I maintain that only the scientific principles underlying manufacturing processes can be learnt at such institutes. ***The actual manufacturing knowledge - how to produce things which can be placed in the World Market at competitive prices - can only be acquired in existing industries.***[71] (Emphasis mine)

As a part of this critique of the nationalist inclination towards for technological institutes Ray was opposed to Tata's Indian Institute of Science. When the plans of its ambitious scale were being drawn, Ray thought it would be a "waste of money and a diversion" and "misapplication of energies".[72] In his opinion, technical knowledge could be better developed in existing institutes with

[68] "Industry Precedes Technological Institute", p. 319.
[69] *Ibid.*
[70] *Ibid.*

[71] *Ibid.*, p. 332.
[72] "Scientific Education in India" (1889), *Essays*, p.9.

the help of handsome post-graduate fellowships.[73] Ray was particularly sceptical about starting a post for Professor of Technological Chemistry at IIS. He suggested that a chosen number of students apprenticed in Europe or America would learn the technical art much more effectively. "It is through the agency of such men that we hope to start the chemical industry by and by".[74]

His experiences with the Bengal Chemicals, which was as much an entrepreneurial venture as a scientific one, had confirmed his ideas. In one instance he entrusted a young man who had only qualified in junior course of Engineering Department of the NCE with the design of the sulfuric acid plant. This man who had grown in knowledge working and expanding the Bengal Chemicals had developed special skills for the chemical industries although he lacked the requisite university education. He successfully designed the plant.[75] Ray's assumptions were confirmed,

> Now, in a technological institute a miniature plant (as is done in junior course class experiments) is shown illustrating the manufacture of sulfuric acid. Miniature models of a *Taj Mahal* are often shown in exhibitions. One can no more erect a Taj from the toy model than can the acid plant from the miniature models.[76]

Thus Bengal Chemicals was not just a swadeshi industrial enterprise. It was one of the first practical attempts to come to terms with the technical realities of industrialisation and to infuse science distinctly within the same. In doing so Ray had provided a crucial blow to the non- – materialist culture of science in the colonial India. If Holland had called for a utilitarian, industry friendly science, Ray had actually asked scientists to learn the intricacies of the market and become entrepreneurs. In his logic with adopting science, Indians must adopt industries, "The great object is to induce the people to become industrialists"[77]

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[73] *Ibid.*, p.16.
[74] *Ibid.*, p.13.
[75] "Industry Precedes.", pp.332-333.
[76] *Ibid.*, p. 333.
[77] "Government and Indian Industries" *Discourses*, p. 237.

Ray's world was thus different from that of the Asiatic Society or even that of Sircar's.

Amidst all these commercial and industrial activities, Ray had come in contact with Gandhi. In Gandhi, Ray found a critique of the industrial world and an advocate of cottage industries. In his own words, Gandhi opened up a new world to him about the realities of his country, about the emotions of its millions of inhabitants and how they had suffered from industrial imperialism,

> The hatred of machinery, the hatred of capitalism which burns so strongly in Gandhi is the reflection of the hate of millions of Indian peasants and hand workers whose traditional basis of existence was completely destroyed by capitalism and who were excluded from the possibility of existence on a capitalist basis as a factory proletariat.[78]

Gandhi brought about certain dilemmas and fresh convictions in Indian nationalism. *Hind Swaraj* which was written in 1906, his first book, contains the fundamental elements of his thought and politics. Here Gandhi articulated his critique of modern civilization. The modern civilization was unacceptable to him because it denied both religion and morality which were at the centre of his own political ideology. The modern civilization only sought to increase bodily comfort. Thus machinery and industrialism, which were at the core of such a civilization represented a "great sin".[79] He saw in large-scale industrialisation the boundless increase of this greed for material consumption.

After such a critique of modern civilization he articulated the cause of *charkha*, a cottage spinning wheel. The *charkha* provided both an economic and moral alternative to that civilization. On the economic front it provided employment to millions of unemployed agrarian labour. It could also be an alternative source of income for India's large agrarian labour.[80]

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[78] "Modern Civilization - Capitalism, Mechanization and Unemployment", *Life and Experiences*, p. 387.
[79] M.K. Gandhi, *Hind Swaraj*, Navjiwan Publishing House, Ahmedabad, 1939, p. 16.
[80] Deepak Kumar, "Gandhi and Technology", *Gandhi Marg*, January – March; 1997, pp. 430 - 431.

On the moral side, *Khadi* represented the true spirit of *Swaraj*. It was the only way to empower, redeem, and activate the millions suffering under the spell of western civilization.[81] It was also his means to demonstrate the moral degeneration of human needs under the monstrous materialism of West, which could be otherwise supported by the small hand-driven wheel. Gandhi throughout his life had seen large-scale industrialism as an evil. In the 1930s Indian nationalism was associating itself more with the idea of modern state and power and thus drawing up plans for large-scale industrialisation to turn India into a modern industrial nation. Gandhi at the same time, was looking for an alternative and argued for an economy of self-sufficient small industries, which would not have to enter into large-scale commodity exchange sale of labour. His concept of economy thus articulated a radically different moral content and logic.[82] In the 1940s he became increasingly suspicious of Nehru's industrial plans. He argued that contrary to what Nehru thought, large scale industries cannot be socialised and thus humanized as the evils were inherent its logic.[83] Once again Gandhi highlighted his moral rejection of the project.

P.C. Ray was deeply influenced by the symbolism of *Charkha*. His famous piece "Gospel of Charkha - Lament of a Spinner", which paid a rich tribute to Gandhi,[84] showed that industrialism was intrinsically related to imperialism. He took the case of Japan, which while successfully adopting western industrialism had also adopted its imperialistic spirit. That was why Japan had occupied Formosa and Korea and was ambitious about Manchuria. He also pointed out how Japan's original simple life was transformed into a highly competitive and ambitious one.[85]

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[81] Chatterjee, *Nationalist Thought*, p. 113.
[82] *Ibid.*, pp. 117 - 119.
[83] *Ibid.*, p. 88. For similar rejection of the big industries see Gandhi's discussion with G.D. Birla, 1935, *The Collected Works of Mahatma Gandhi*, The Publication Division, Ministry of Information and Broadcasting, Government of India, 1958, vol.62, p.145; also see his speech at a meeting in Lusanne, *Ibid.*, vol.48, pp.403-406.
[84] "Gospel of Charkha - Lament of a Spinner" in *Life and Experiences*, pp. 361 - 377.
[85] "Modern Civilization - Capitalism, Mechanization and Unemployment", *Life and Experiences*, p.392.

Ray realised that India's poverty had its root in this industrial imperialism, "it is not necessary to multiply instances to prove how millions of spinners, weavers, cutters, smiths, boat - men and carters have had their breads snatched away from their mouths by the triumphant march of modern 'civilization'".[86]

He had also realized that, "After all, India is an agricultural country and must ever remain so". Thus the greatest of India's concerns were of agricultural nature like - productivity of soil, village economy and could not be solved by large-scale industrialisation.[87] Ray even spoke out against the Indian craze for industrialistion. On the occasion of opening a Swadeshi Exhibition at Madras, July 15, 1930, he said,

> The craze for industrialisation had seized many of our public men, but the example of Europe and America ought to be our eye - opener, as has been well said - "Half the people in industrial countries are rocking their brains in labour saving appliances and the other half in solving the question of unemployment.[88]

But how did Ray come to terms with the two worlds - one of heavy chemical industries and the other of Charkha? We have to remember here that the two involvement continued simultaneously. Even after his association with Gandhi, Ray had continued to admire the German chemical industries. Chemical industries were taking huge strides towards large-scale productivity in Europe during this time. Ray was always fascinated by the achievements of large scale in industrialisation of Europe, how the introduction of Gay - Lussac and Glover's towers and the 'contact' process had increased the output of sulfuric acid by leaps and bounds, in the rubber industry the consumption of caoutchouc had revolutionised production scales.[89]

It was particularly Germany which always stirred the chemist's imagination. After a visit to the country he wrote, "I have recently (1926)

[86] *Ibid.*, p. 372.
[87] *Ibid.*, p. 375.
[88] *Ibid.*, p. 383. footnote 2.
[89] "Industry precedes Technological Institute", p. 330.

returned from a visit to Merck's at Darmstadt. The stupendous dimensions of the works filled me with awe and wonder."[90] He was particularly impressed by the dye - stuff industry of Germany. The scale of their functioning were huge, as he added with wonder that Badische Anlin and Soda Fabric firm utilised 42 miles of railroad for transportation within the plant. Its water tank supplied 10 billion gallons yearly and its ice factory 12,000 tones of ice.[91] He had thus realized that chemical industries if they had to survive in this country, had to be operated on a large scale. That is what he advocated, at the same time while he was talking of charkha and the evils of European industrialism,

> From the foregoing observations it will be seen that the local manufacture of alkali is urgently necessary to meet gradually increasing requirements for the developments of other Chemical Industries.... The most important (sic) is that unless the manufacture is conducted on a very large scale economical production of the alkali and various by - products, so as to compete with imported article, is believed to be impossible. The capital already sunk in the alkali works in England is enormous and from the Indian point of view, simply colossal.... Unless a captain of industry with the genius and resources of a Tata were to enter the field, I am afraid, there is very poor chances of success.[92]

He added that the development of chemical industries depended on the economic utilisation of its by - products which needed a general industrial development.[93] In other words Ray was arguing for the case of a general large-scale industrialisation of India.

One reason why these two contradictory logic could co - exist in Ray was in his particular reading of Gandhism. Though an ardent follower of Gandhi, Ray shared none of Gandhi's critique of rationality and the scientific mode of knowledge or the political and moral content of his *Khadi* movement. Gandhi was opposed not only to the modern industrial civilization but to the predominance of rational knowledge in that civilization. He explained the famous

[90] *Ibid.*
[91] "Possibilities of Chemical Industries in India", *Discourses,* p. 96.
[92] *Ibid.*, p. 56.
[93] *Ibid.*,

earthquake in Bihar in 1934 in terms of 'divine chastisement' against untouchability thereby rejecting scientific logic completely.[94] This had put him in conflict with Tagore, who, like Ray, had otherwise shared with him apprehensions about the industrial world. To Gandhi truth was beyond rational knowledge. It was moral and could be achieved through moral practice. Ray had firm faith in the superiority of scientific truth. The moral content of Gandhi's thought were, in the last instance, alien to him. Ray had thus advocated the *Charkha* as an economic agency, ignoring its more fundamental moral and political message.

To Ray the *Charkha* was ideal because it had universal application in India. It could provide subsidiary employment to the millions of agricultural unemployed population. To that extent they were much more desirable than the cotton mills of Bombay and Kanpur which catered only two an urban minority:

> The Bombay cotton Mills at best give employment to 3 or 4 lacs, and the Cawnpur mills find occupation, it may be for another couple of lacs. Utmost two millions earn their bread in the industrial centres of India, but what about the remaining 318 million? Will you wait till Manchester, Liverpool, Glasgows and Dundees spring up here and transfer 70 percent of the rural population to the urban areas? ***Are you going to industrialise rural India?***[95]

The realisation of the enormity and the sheer impossibility of the rapid industrialisation of India to an extent to solely solve India's problems had pushed him towards *charkha.* He added, "with the exception of Calcutta and Howrah there are towns in Bengal. The district towns are only towns in name; they are the localities where the law courts have sprung up and they support a parasitic population. I am afraid you will have to wait till doomsday".[96]

Thus *Charkha* could provide immediate employment to the agrarian majority. It did not pose to oppose large - scale industry but serve within its particular sector from where it was compatible with that industrialism. Ray's

[94] See Chatterjee, *Nationalist Thought*, p. 96.
[95] "Gospel of Charkha", p. 374.
[96] *Ibid.*, p. 374 - 375.

involvement with *Charkha* as an economic alternative, was now successfully incorporated within the modern industrial logic. It is needless to add that on this economic logic, his *Charkha* ultimately could not compete with the larger industries in a modern industrial world. Whenever the interests of the two were in conflict Ray would always support the cause of modern industry. While talking of India's large scale leather imports, he argued for the replacement of the cottage industries with the modern scientific ones as the former implied inefficient techniques and wastage, "bark tanning of a crude sort is done in madras by *Chamars* but the experts are of opinion that the unscientific process adopted by them only deteriorates the quality of the skin".[97] Ray concluded that large-scale industrial production of leather using modern chemical knowledge was the only solution.

Secondly, Ray's ambivalence stemmed from this contradiction within Gandhianism itself. Gandhi himself had not always maintained the distinction between the moral and the economic priorities of *charkha*.[98] Gandhi's position often was not of a total rejection of big industries. In his discussion with economists at Wardha, 1938 at a time when Congress was instituting the Planning Commission, he sounded rather ambiguous. While 'emphatically' rejecting all the instances of big industrial enterprises in India Gandhi accepted on principle the co-existence between large and small-scale industries purely based on economic criteria.[99] Gandhi had ultimately failed to solve the contradictions between modern industry and *Khadi*. He had failed to articulate as a viable political alternative to modern industry in a modern political state that his struggle had ultimately achieved.

As pointed out by Chatterjee this reflected a larger problem in Gandhian political thought.[100] Gandhi could not develop his moral concerns into a political

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[97] "Possibilities of Chemical Industries in India", p. 66.
[98] Chaterjee, *Nationalist Thought*, pp.117-120.
[99] *Collected Works*, Vol.LXVIII, pp.258-259; also see Gandhi's interview by P. Ramchandra Rao, Panchgani, 1945. *ibid.*, Vol.80, pp.352-353.
[100] *Nationalist Thought*. pp. 117 - 123.

programme which provided a practical political alternative. His ultimate recourse to individual morality and faith as the greatest motivating force meant a compromise between contradictory ideologies under his influence. One such unhappy compromise that he maintained throughout his career was one between the political ideology of *Khadi* and the Indian bourgeoisie. Gandhi's faith in individual morality and subsequent lack of political alternative sought to maintain the same faith on the capitalist class as it had on *Khadi*. The political interest of one went directly against the other. This only meant the radical political potentials of *Khadi* could never be articulated or activated. It was Gandhism which had originally conceded this co - existence between modern and cottage industries allowing it to be appropriated successfully within the mainstream bourgeoisie political ideology.

P.C. Ray, I would like to argue, in spite of his advocacy of *Charkha* ultimately conformed to the morality of the modern industrial west. This is where Ray becomes different from S.C. Mukherjee and even P.N. Bose who had talked of industrialism in an alternative cultural and moral world order. Yet what is striking about Ray is that he belonged to both the worlds. He shared S.C. Mukherjee and P.N.Bose's apprehensions of western industrialism and yet advocated German chemical industries. Somewhere, beyond the reasons cited above, the contradictions of the two worlds remained unresolved. It remains is still difficult to explain why the same Ray who once saw the evil of imperialism as a natural outcome of European industrialism even in the non - west Japan, advocated the same Japanese model for India.[101] Sometimes, may be, such contradictions are not completely resolved within the framework of one's thinking. The scientist entrepreneur and the ascetic Gandhian in Ray perhaps remained strangers to each other.

This anomaly led to Ray's refusal to confront the broader implication of either Gandhian or Western industrial discourse. His method was that of

[101] "Government and Indian Industries" *op cit*, p. 237. Ray advocated in his evidence to the IICOM the Japanese model of forced industrialisation against the British *Laissez faire* one.

appropriation of the element from diverse frameworks, ranging from *Charkha* to the chemical industries of Germany without negotiating the contradictions that they suggested. His ideas thus, represented an eclectic co-existence of opposing elements of thought. His silences suggest a massive repression and his failure to work out a comprehensive structure of industrialism.

To go back to our earlier point, P.C Ray's industrialism was different from either S.C. Mukherjee or P.N.Bose. His industrialism did not seek for itself an alternative political or moral order other than the west. In spite of his *Charkha* his industrialism had to some extent freed itself from the moral dilemmas of anti-industrialism.

In many ways these shared the elements of a larger ideology, the ideology of secular industrialism. By this I mean the metropolitan industrial logic which insulates itself from moral, political and cultural questions. It creates a world for itself where its own logic becomes the supreme morality. It can then cut across any political, cultural and geographical boundaries. This logic had always existed in Indian history parallel to the dilemmas that we have studied. The Indian League debate against Sircar, the NCE controversy point are instances of the same. In P.C. Ray's case we have seen how his *Charkha* had failed to curb the logic of this industrialism. However, by the 1930s, the debate gradually tended resolved itself with secular industrialism emerging triumphant in the Indian context. The person who played the most decisive role in it was Jawaharlal Nehru. His career demonstrate how effectively the alternative moral issues could be appropriated within the metropolitan industrialism.

The core of Nehru's faith in western rational ideas was his belief that growth was the most crucial aspect of life. "Life is a principle of growth, not of standing still, a continuous becoming which does not permit of static conditions."[102] It was through such a dynamic process that a fuller and more

[102] Jawaharlal Nehru, "The Modern Approach to an Old Problem", *The Discovery of India*, Signet Press, Calcutta, 1946, Collected in Baldev Singh (ed) *Jawaharlal Nehru on Science and Society; A Collection of his Writings and Speeches*. NMML, Teen Murti House, New Delhi, 1988, p. 39.

integrated truth emerges. It was this growth that guaranteed the prosperity and superiority of a nation or civilization. To that extent it was the rational west which represented that growth while the Oriental east had remained static, "certainly India and China must learn a great deal, for they had become static and the West not only represents the spirit of the age but is dynamic and changing and has the capacity for growth in it, even though this function through self - destruction and periodical human sacrifice."[103]

Having made his choice Nehru located a rational past in India itself. To him that was the 'true' India which had to be retained while the rest, "the dirt of the ages" needed to be thrown out,

> .....all the dust and dirt of ages that have covered her up and hidden her inner beauty and significance, the excrescencies and aberration that have twisted and petrified her spirit, set it in rigid frames, and stunted her growth. We have to cut away the excrescencies and remember afresh the core of the ancient wisdom and adopt it to our present circumstances.[104]

Thus the creation of a new modern India was formulated. The chosen past had to be chiseled out to suit the present requirements. That would facilitate the smooth creation of a rational modern Indian nation. Then it would not require the imposition of an alien nationalism. "In India in many ways we have a greater distance to travel. And yet there may be fewer major obstruction on our way, for the essential basis of Indian thought for ages past, though not its manifestations, fits in with the scientific temper and approach as well as with internationalism."[105]

Thus P.C. Ray and J.C. Bose's search for an Indian science and rationality had reached their larger political articulation towards the creation of a nation state. Nehru's socialism had taken its inspiration from the economic progress achieved by the Soviet Union. He believed that India had to learned from Soviet planning. But India was yet to show the general possibilities that could urge the course of a planned industrial growth. His planning was thus based on a concept

[103] *Ibid.*, p. 40.
[104] Nehru, "Religion, Philosophy and Science" in *The Discovery of India*, p. 34.
[105] *Ibid.*, p. 37.

of long-term 'regeneration' which would ultimately lead to socialism.[106] To him planning was inevitably connected with a socialist economy within a democratic structure. As S. Gopal suggests, Nehru kept his formulation 'deliberately imprecise' because he had no wish to frighten away either the Congress leaders or the people from such a course.[107] Nehru's ideas had to be based on such a pragmatic, undefined approach as the Congress had neither adopted socialism or the large-scale industrialisation of the Soviet model. His ideas were also a reflection of the complex disagreement that ensued between him and Gandhi, fuelled certainly by Gandhi's own ambiguity. On the one hand Nehru had rejected the Gandhian viewpoint that machines were evil in themselves and resigned from executive committee of the All India Spinner's Association. On the other hand, Nehru had to incorporate Gandhism within this logic of modern industrial nationhood, partly because the country had identified with Gandhian nation and also because of this close association with Gandhi and the fact he took pride in calling himself a "Gandhiite".

This struggle and his attempted resolution of the two was evident in a letter that Nehru wrote to Aldous Huxley refuting his characterization of Congress views as anti - science. Nehru argued how Congress and particularly Gandhi's ideas were compatible with modern, rationalist philosophy:

> He wants, as far as possible, to decentralise industry, to have small units and not large ones, and for this purpose he wants to take the fullest advantage of the scientific method. He thinks that this ought to suit modern, condition but in case it does not, why then, he is perfectly prepared to have something else. In either event there is no question, so far as he is concerned, of ignoring any advantage that science has to offer.[108]

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[106] Sarvapalli Gopal, *Jawharlal Nehru: A Biography, Vol. I, 1889-1947*, OUP, Bombay, 1976, p.245.

[107] *Ibid.*

[108] "Science and Gandhi" (Letter to Aldous Huxley refuting his characterization of Congress views as anti - Science) in *Selected Works of Jawaharlal Nehru*, Orient Longman Ltd., New Delhi, 1973. (First Series), Collected in Singh (ed) *op cit*, p. 16.

Thus the entire moral and cultural moorings of anti - industrialism were reduced to organisational changes. Nehru even dissociated himself and the Congress ideology from these ideas. Despite having referred to himself as a "Gandhiite"[109] in the beginning of the letter, he pointed out, "Personally, I do not agree with it, and I should like to make it clear that Indian Congress, and the National Movement have not adopted it."[110] He added that Congress stood for large - scale industrialisation of the country. Having stated that, it was now necessary to locate *Charkha* in such a scheme which also had been adopted by Congress,

> The Congress has recommended hand - spinning to the agricultural classes of India not because of any hostility to machinery or science, but because of special reasons applicable to the Indian peasant under present conditions. The spinning wheel is not to be a rival of machinery - it would be absurd to say so; nor is spinning to take the place of any other occupation.[111]

To Nehru, *Charkha* was to be compatible with large-scale industrial development in much the same way as Ray had suggested. It was to provide an additional source of income to the agricultural population, as a "secondary occupation, an auxiliary industry for him".[112] Having thus situated hand spinning within his vision of modern India, Nehru argued as to why from this economic point of view *Charkha* could never replace large scale industry. Here he described how his understanding of Gandhism would ultimately lead to, paradoxically, industrialism,

> The obvious way to absorb these scores of millions of unemployed and partially employed is to provide other occupations for them by industrialising the country. Hand spinning cannot solve these problems or put an end to unemployment, whole time or seasonal. If we had the state power in our hands we would certainly adopt a host of other methods, including industrialisation.[113]

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[109] *Ibid.*,
[110] *Ibid.*, p. 17.
[111] *Ibid.*
[112] *Ibid.*
[113] *Ibid.*

But Nehru was not finished with *Charkha* yet. He added that it was *Charkha* which was morally unacceptable to him. His radical socialism did not approve of the socio - economic structure that it represented. Here he hinted that in the future socialist nation state, *Charkha* might cease to exist,

> The real objection to widespread cottage spinning is that by bettering slightly the conditions of those who adopt it, it helps to prop up a land system and an economic structure which are indefensible and which are in a process of breaking down. A radical socialist would rightly object to this attempt at propping up a doomed structure.[114]

Nehru had ultimately rejected *Charkha* as a feudal institution. This demonstrates how Nehru's vision of an urban industrial India was getting structured very rigidly on the European model. He was not willing to experiment with the elements that did not conform to that structure. While on the question of science, his nationalism was ready to distill it from its Indian tradition and adapt it, in the modern context but as far as hand - spinning was concerned he was not ready to isolate it from its feudal links and adopt it in a new socio - economic structure.

But if Nehru was still discussing *Charkha* and attempting to locate it within his industrialism, for others that did not seem necessary. Their aggressive secular model of industrialism was insulated completely from such moral and political issues. One such personality was Madan Mohan Malviya.

Malviya's note of dissent to the Indian Industrial Commission (1918) shows how deeply the industrial logic had embedded itself nationalist discourse.[115] His note began with drawing a picture of the Indian industrial past, thereby legitimising its logic within its heritage. It was the modern industrial - imperialism of Europe had led to its deindustrialisation. This was what had reduced India into an agricultural country only in the recent past, earlier she had

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[114] *Ibid.*

[115] "Note by the Hon'ble Pandit M.M. Malviya" in *Indian Industrial Commission Report - 1916 - 1918*, Superintendent of Government printing, India, Calcutta, 1918, pp. 292 - 355. For a detailed account of Malviya's arguments see Viswanathan *op cit*, pp. 45 - 51.

been a premier 'manufacturing' country.[116] Through this logic he sought to contest the predominant idea that the "people of India are by nature and tradition deficient in industrial capacity and commercial enterprise, and that these qualities are inherent in the nations of the West"[117] This characterization had also effectively tackled the issue of a moral dilemma for an industrialised Indian future.

In his commitment towards that future Malviya suggested a widespread and comprehensive plans of technical education. The first step was to make primary education universal with drawing and manual training introduced within such an education. On this base the higher technical and engineering colleges should be promoted. The universities too should be vitalized with technical courses to spread the spirit of technology at a general level.[118]

It is on this point that Malviya had differed from the recommendation of the IICOM. The recommendation of the Commission, he felt, did not provide enough impetus towards the growth of such a society. He argued that the British model, on which the Commission had motivated itself, was incapable of fulfilling such ambitions. He rejected the British *laissez faire* policy in favour of direct and active state intervention in industrialisation. The state itself had to become more technology - oriented along with the schools and the institutes. The general transformation could only come, Malviya argued, if the state took up the responsibility for its industrialisation.[119] It was for this reason that he found the German and particularly the Japanese model more acceptable. He argued that India should mould itself on the Japanese model which had sought to bring about a comprehensive technical aptitude among the masses, engineered by the state. His suggestions for the education system thus closely follow the Japanese system.[120] Japan had already gathered a widespread appreciation in the nationalist

[116] *Ibid.*, pp. 294 - 297.
[117] *Ibid.*, p. 294
[118] *Ibid.*, pp. 322 - 332, particularly pp. 327 - 331.
[119] *Ibid.*, pp. 314 - 317.
[120] *Ibid.*, pp. 325 - 327.

search for an industrialised India. The argument being, like Japan, the British should encouraged Indian industries. Japan's rapid industrialisation in the decades leading to the first World War upon western methods, shattered the illusion that industrialisation was a uniquely western process. Thus by the 1890s, and especially after its victory in 1894-95 Sino-Japanese War, Japan was accorded a special status among non-western societies.[121]

Malviya's dissent was thus not a pose critique of Holland's essential industrialism. If anything Malviya demanded a model that ensured a more comprehensive progress towards that. Holland in fact had become a 'hero', a pioneer of the industrial process in India in the nationalist discourse. To the Indian scientists his IIMG was a great precursor to the nationalist research projects.[122]

Thus to Malviya industrialism was an organizational issue rather than political or cultural. It was for this orientation that he argued in terms of models ; the British, the German and the Japanese. In many ways these ideas infested a new urgency on the questions of industrialisation and modernization. These were instances of a 'high modernity' representing the ideas of rational engineering of entire social orders in creating realizable utopias.[123] Such ideas were based on certain fundamental premises. First, a new concept of authoritarian state, driven by utopian industrial plans and the urge to order nature and society. This new state also represented a disregard for the values, desires and the objections of its people. Second, a strong self-confidence about scientific and technical progress,

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[121] For a critical analysis of this Indian nationalist fascination for Japan see, Dewey, "The Government of India's New Economic Policies....", *op.cit.*, pp.249-250. He shows that the advocacy of Japanese model ignored the vast contrast between the two countries, as well as the ones assessed the Japanese success.

[122] P.K. Ghosh in his Presidential Address, to the Institute on its fiftieth anniversary (1956) spoke on the "Contribution of the Institute to the Mineral Industry of India". Narrating the history of mineral researches in British India, he saw the birth of the institute as the "Dawn of the industrial Era".[122] He called Holland's period as the 'Heroic Age', "Presidential Address" *Transactions,* Vol. 53, April, 1956. pp. 47 - 61. The nationalist metropolitan industrial discourse of India had thus a mixed heritage. The industrial ethic could wipe out the political and cultural divergences.

[123] I have borrowed the term 'high modernity' from James C. Scott, see his *Seeing like a State, How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press, New Haven and London, 1998, pp.4-6.

the growing satisfaction of human needs, the mastery of nature (including human nature) and the rational designing of social order commensurate with the scientific understanding of natural laws. This was fostered by the fact that the new factory systems of Europe gave rise to an industrial culture with distinct ethics of time, work and discipline.[124]

The ideas of a powerful state had developed simultaneously with the emergence of modern economics and the philosophy of planned growth. In the last decades of the 19th century, with the arrival of mammoth manufacturing corporations with trading cartels, the notion of a self-regulating economy in which decisions resulted from the uncontrolled interplay of divergent interests was replaced by the notion of identifiable people manipulating social forces to bring about a predetermined objective. This gave rise to modern economics as against the classical one which believed that the world was governed by objective economic laws. Now economics became instrumental in conscious regulation of economic behaviour. The old concept of the 'night watchman' state was fast withering away. The new world was witnessing the transition from economic laissez-faire to economic management, from the unconscious to the conscious.[125]

The celebration of modern technology as creators of a new world was to a large extent an American phenomenon. The transformation of America from a patchwork of settlements to a nation demonstrated how technological advance, and mastery over the natural world were essential to the growth of a new world. America from the 1880s, as Adas argues, represented a celebration of the machine, many Americans regarded machines as the object of aesthetic pleasure, or divinely ordained instruments for building the nation and strengthening its moral resolve.[126] The other instance of such celebration was far removed from the capitalist world; Soviet Russia. Although the Soviet Union had rejected the

[124] For a detailed analysis of this point, see, Michael Adas, *Machines as the Measure of Men; Science, Technology and Ideologies of Western Dominance*, Cornell University Press, Ithaca and London, 1989, pp. 241-270.
[125] See E.H. Carr, *1917: Before and After*, Macmillan, London 1969, pp.10-11.
[126] Adas, *op.cit*, pp.405-406.

role of marked and private capital in the development process, it demonstrated the manifestation of the technological ethic that celebrated man's victory over nature. It too considered the traditional methods and institutions as impediments to the inevitable transformation of backward economics and societies. The 'social engineering' methods of the Soviet Union were rooted in heavy industrialization and the application of science to every thing from production to social organisation.[127]

These developments marked the high tides of modernity. The feats of national economic mobilization was particularly attractive to the visionary intellectuals and planners of the non-industrialized countries who were animated by a genuine desire to improve their human conditions. In the Indian context a comprehensive initiative towards that was taken by a group of intellectuals, led by the physicist Meghnad Saha, through their journal *Science and Culture.*

Science and Culture and the 'Scientific Culture'

The most significant fact about *Science and Culture* was the political climate within which it emerged. In 1936, the Indian National Congress decided to contest the provincial elections under the Government of India Act of 1935 with a view to fight the Act from within the Assemblies. This brought Congress for the first time in touch with the state power and the question of a state formation under them became a realistic possibility. Henceforth Congress deliberations were increasingly being governed by the choices for a future nation state. By 1936 Nehru had clearly articulated the ideals of science and socialism as the paths for the future nation. He had clearly visualised the role science was going to play in future India's industrial progress.[128]

The other important factor was the emergence of a group of scientists who shared certain visions of an industrialised India. Scientists like S.S. Bhatnagar,

[127] *Ibid.*, p.416.

[128] Nehru, "Before India is Reborn", *Selected Works of Jawaharlal Nehru (First Series)*, Orient Longman Ltd. New Delhi, 1973, Vol. 7, p. 8636.

P.C. Mahalnobis, Saha and Homi Bhabha developed the industrial research imperatives of India. They provided the framework for the emergence of a future scientific and technological research system. In the decade before and after the independence, these scientists were to play crucial roles in formulating science's close links with the Indian state. This was facilitated by the close association that these scientists established with the young and energetic politicians of the day like Nehru and Subhash Bose.

One of the earliest articulations of India's industrial imperative came from the physicist M.N. Saha who had joined the faculty of Allahabad University. Saha was influenced by Ray to apply science to the cause of Indian problems. His initial engagements were with flood control.[129] At the same time he took an active interest in the emergence of science as a professional occupation in India. In 1932, he was the President of the UP Academy of Sciences. He next played the key role in forming the National Institute of Sciences in 1934.[130] The same year Saha in his Presidential address to the 21st session of Indian Science Congress at Bombay, advocated the large-scale application of science and technology to national life.[131] He also helped the establishment of Indian Science News Association (ISNA) in 1934. The ISNA founded a magazine in 1935, *Science and Culture*, which was to become the mouthpiece of ISNA, Saha and all others who agreed to them.[132] *Science and Culture* was thus the culmination of Saha's two parallel interests. The first was the role of science and technology in Indian development and the second was in developing a community of like minded scientists and the initiation of a larger dialogue to constitute a scientific culture and ethos. Saha's contact with the political leaders was almost immediate. Already in 1936 he had written to Nehru discussing his plans. In 1938 when Subhas Bose became the President of Indian National Congress, Prof. Saha persuaded Bose to set up the National Planning Committee and insisted that

[129] See Saha, "Catastrophic Floods in Bengal and how they can be controlled" *Modern Review*, 51(2), Feb. 1932, pp.163-166.
[130] Viswanathan *op cit*, pp.98 - 99.
[131] "Presidential Address" *Proceedings*, ISCA. 1934, vol.21, pp.40-41.
[132] Viswanathan, *op cit.*, pp. 99 - 100.

Nehru should be its chairman.[133] As a vehicle to promote such an industrial culture the journal was designed as a popular one to discuss wide ranging issues. Over the years contribution from scientists, politicians and general intelligentsia debated the various aspects of an industrial future of India.

The group in its pages had advocated a forced march to industrialisation, nationalisation of power and fuel, multipurpose development of rivers, establishment of scientific surveys, research laboratories, training of large personnel in scientific and technological knowledge and development of educational facilities for all.[134] The journal had also announced its ovation to mechanization emphatically, "...future belongs to those who know how to use machines as slaves and not ask human and animal muscles to bear the strains which machine can bear."[135]

At a basic level *Science and Culture* wanted to promote, like Ray, a close links between science and industry. The west European models in this regard were similarly held in high esteem. While reviewing the organisation of scientific research in the United Kingdom in aid of British industries, the editorial asserted, "every industrial organization in India ought to realize that it is high time now that a close cooperation between science and industry existed. Scientific industrial research very rarely receives at present all the encouragement which it deserves, and the country must wake up to its call without further delay."[136]

The journal added a new feature from its second year named 'Science in Industry' to address the question of industry more directly and link science and industry closely. It published scientific news and notes which were mainly of industrial interest. Moreover, the larger issues of applications of science to industry, both on the side of technique and organisation with special reference to

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[133] Singh, Baldev, *op cit.*, p. xvi.
[134] "Twelve Years of Science and Culture", *Science and Culture* (Henceforth *S.C.*), July, 1947, Vol. 13, no. 1, pp. 1 - 2.
[135] "Technical Education", *S.C.*, Vol. 13, no. 1, August 1947, p. 43.
[136] *S.C.*, Vol. II, no. 9, March 1937, p. 413 - 416; p. 416.

Indian conditions were also addressed.[137] The journal announced this feature as in conformity to its basic objective, " In starting this feature we are only taking a step towards fulfilling one of the principal aims with which this journal was started, namely the application of science to national development and economic welfare."[138]

On the one hand the journal was attempting a consensus among scientists on certain key issues of industrial research to address them to the Government. In 1938 it published the resolutions passed by M.N. Saha at the National Academy of Sciences (29th March, 1938).[139] These were specific suggestions to the Government by the scientists on power research. The suggestions included forming permanent bodies for power research and survey, hydro - electricity, fuel-engineering etc. The same year it published the "Bombay Chemists' Suggestions for Industrial Development."[140] The chemists suggested the creation of a Provincial Scientific and Industrial Research Council, revival of workers' guilds, remodeling of technical education and technical institutions, co-ordination between research - work and industries throughout the Bombay Presidency and the reorganisation of the Department of Industries to enhance its utility.[141] They also pointed out their need for an industrial survey of the national resources and a systematic planning of industries according to the requirements of the Presidency. In their scheme the Government should, on the advice of the proposed council, take steps to establish closer and more efficient contact between scientists and industrialists and between scientists and public leaders.[142]

On the other hand the journal published contributions from politicians like Nehru and Subhas Bose who saw it as a forum to realise their visions of a 'modern' India. Nehru appeared regularly in the pages of the journal. His speeches and addresses which shared with it the idea of an industrial society

[137] *S.C.* , Vol II, no. 7, 1936, p. 350.
[138] *Ibid.*
[139] *S.C.*, Vol. III, no. 11, May, 1938, p. 621.
[140] *S.C.*, Vol. III, no. 12, June, 1938, pp. 667 - 668..
[141] *Ibid.*
[142] *Ibid.*, p. 668.

were duly appreciated. Most celebrated was his call for a joint effort by politicians and scientists in creating a new India,

> We have vast problems to face and solve. They will not be solved by politicians alone, for they may not have the vision or the expert knowledge; they will not be solved by the scientists alone, for they will not have the power to do so, or the larger outlook which takes everything into its ken. They can and will be solved by the co-operation of the two for a well - defined and definite social objective.[143]

In Nehru's vision thus scientists and politicians represented 'knowledge' and 'power' respectively. Their co-operation would produce the heady mix of the two which was so vital for a modern industrial society.

Subhas Bose's, interaction with *Science and Culture* reveals the specific nature of industrialism around which the consensus was forming. He looked up at the journal to provide some vital clues to the social issues that concerned the politicians in their 'nation - building',

> The appearance of *Science and Culture* is to be warmly welcomed not only by those who are interested in the abstract sciences but also by those who are concerned with nation building in practice. Whatever might have been the views of our older "Nation-builders", we younger folks approach the task in a thoroughly scientific spirit and we desire to be armed with all the knowledge which modern science and culture can afford us.[144]

He had some specific social issues in mind for which he expected solution from *Science and Culture* towards an organised industrial nation. They included questions of age and nature of Indian civilization, the ways to revive that civilization "that has begun to stagnate", whether promoting inter - caste marriages would genetically improve the 'Indian race', the maximum population that India should have, a common script for India, uniform diet for Indians, uniform dress - code for Indians, etc.[145] He concluded by saying, "I shall now ask

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[143] "Need for Co-operation of Scientists and Politicians", *S.C.*, Vol. III, no. 10, April, 1938, pp. 546 - 547.
[144] Subhas Ch. Bose, "Some Problems of Nation-Building," *S.C.*, Vol. I, no. 5, October, 1935, p. 258.
[145] *Ibid.*, pp. 258 - 259.

our scientists to take up these problems one by one and give satisfactory answers. Without the co-operation of science, no nation building is possible."[146] Bose's concerns here reflect the emergence of a particular rational utopia. This search for that rational future was marked by as Nandy argued, a certain "scientificity", which turned utopia-building itself into a science.[147] It promoted the search for a future as a search for certitude and technical finish as against the imperfect political and social consciousness.

It was this scientificity that particularly characterised the group's discourse. India's poverty and 'backwardness' were now explained in the terms of her lack of scientific industialisation. The larger context of caste, colonialism, politics and morality within which Ray, Gandhi and others had located their critiqued of colonial and pre-colonial India was missing here. Modern science and technology thus appeared as the only means to usher a 'new' India. Typically the papers would begin by pointing this out. The opening lines of an article on the "Need of a Radio Research Board in India",

> It is only too well known that compared to other civilized countries of world, India is deplorably backward in many matters of vital importance. The deficiency is nowhere more conspicuous than on those branches of national activity which directly or indirectly depends on the application of modern scientific knowledge....[148]

The focus was not just to link up science and industry but to promote a new industrial culture. The aggressive industrialism of *Science and Culture* was prepared to cross newer boundaries and urge a more radical transformation. To that extent it had internalised the logic of western industrialism further. Prof. Pulin Behari Sarkar of Department of Chemistry, Dacca University showed how far the scientific community had come to terms with industrialism. While discussing how to produce petrol from coal, he mentioned, as a matter - of - fact, the blood-chilling aspects of such an industrialism that India would have to adopt.

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[146] *Ibid.*, p. 259.
[147] Nandy, "Evaluating Utopias....", pp. 10 - 11.
[148] *S.C.*, Vol. II, no. 10, April 1937, p. 469.

This statement shows how not only the cold logic of industrialism but even the imperialistic connotations of it were now internalised within the nationalist discourse,

> In the present century, a powerful nation should not only free itself but also possess an immense potentiality to deprive other people of their freedom, it must not only be in possession of huge national wealth in the form of national resources but also be active in fully utilizing them by intensive industrialisation, it should not only be extraordinarily capable of killing thousands of men in the shortest possible time and at a moment's notice but also have unique capacity for exploiting weaker nations. As a matter of fact, the strength of a nation is determined now - a - days by the number of warships, aeroplanes, machine guns and submarines it possesses, and also by its capacity of providing huge quantities of war - materials, 'poison gas', etc. Industrialisation of a country is thus an essential factor in world supremacy and for this purpose irons, coal and oil are indispensable.[149]

The ferocity of this industrialism was directed not just towards the outside, it sought to encounter the domestic with equal intensity. Foremost in its agenda was an internal ordering; a standardisation of people's life-patterns, their food, their cloths, their intelligence, their occupations. One of the important components of such an industrial regimentation was urbanisation. Saha argued that only a large scale urbanisation of India would resolve India's problems, something that P.C. Ray had earlier rendered unrealistic, "...large proportions of the village populations is to be diverted from the task of food gathering to industrial work. In fact, the only way to improve the villages is by drafting more villagers to the cities, and by creating a large number of cities based on industries."[150]

In such a transformation of the countryside, agriculture needed to be regulated and planned as well. Here the model was United States, where scientific regulation of its agriculture had helped in the creation of its 'New World'. The message was to replace the past with the promise of a new future. A paper

[149] Pulin Behari Sarkar, "Petrol from Coal" *S.C.*, Vol. I, no. 13, June, 1936, p. 732.
[150] "Need for the Power Research and Investigation Board in India" *S.C.*, Vol. III, no. 8, February 1938, p. 406.

advocating the American model discussed how the Red Indians were logically replaced from their lands by a superior mode of agricultural technology. This had given the country its peace and prosperity.[151]

> Now the same land supports hundred times the population living in the highest comfort and plenty, and there is not any occasion for them to fight. This is because the new race which has succeeded the Red Indians is fully equipped with the art of the development of the resources of the land, which has been fully utilised by them. If people of Bengal want to live a better life than they do now, they must pool their resources together and develop the agricultural potentials of the land to the fullest extent according to a planned system.[152]

Over the years *Science and Culture*, produced several articles, particularly by J.C.Saha, advocating the American model of agricultural research and organisation for India.[153]

Closely related to agriculture was the concern for food. Diet and nutrition attracted a lot of attention in the pages of the journal. The concern was to scientifically standardize diet as a pre-condition for nation-building and for an industrial society. B.C. Guha of the Indian Institute of Medical Research gave a call for what he called "rational - feeding" as against "instinctive" eating.[154] The inspiration was from the food rationing experiences of the First World War which were found 'strikingly' suitable for peace time diet planning to offered 'optimum nutrition'. He proposed to form a Central Nutrition Board, "which should carry on researches in purely scientific as well as applied aspects, and should form an authoritative body for controlling and directing the dietary habits in this country

[151] J.C. Ghosh, "The Need for Crop - Planning", *S.C.*, Vol. I, no. 5, October, 1935, pp. 250 - 257.
[152] *Ibid.*, p. 251.
[153] For example see, "Re-organisation of Agricultural Departments in India", *S.C.*, Vol.4, May 1949, No. 11, pp.440-441. "Organisation of Finances of Agriculture in India", *S.C.*, Vol.14, No.12, p.485; Those were several articles by J.C., Saha who had visited U.S.A. to study their agricultural research like- "US study their agricultural research", *S.C.*, V.15, No.4, October, 1949, p.128; "Need of a Comprehensives Planing for Development of Agriculture in India", *S.C.*, Vol.5, No.10,April 1950, p. 369, followed by another article on "Agricultural Extension Services in the US "by J.C. Saha, p.371; "Agricultural Education and Record in India", *S.C.*, Vol. 15, No.12, June, 1950, p.455.
[154] "The Problem of Nutrition", *S.C.*, Vol. I, No. 7, Dec. 1935, p.399.

both for individuals and for institutions".[155] The Indian Nutrition Committee was accordingly set up in February 1936.[156] Simultaneously, there was a critique of traditional food habits which lacked in 'scientific planning' and nutrition. In 1936, Dr. H.E.C. Wilson, Professor of Biochemistry and Nutrition, All-India Institute of Hygiene and Public Health, pointed out that the Bengali diet was 'sadly deficient' in protein content.[157] He showed how the Bengali diet was markedly below European standards in protein, which was "found to lead sooner a later to a reduction in the body mass or in sub-normal growth".[158] Remedies were not hard to seek. The recommendations of the Mixed Committee of Nutrition of the league of Nations on "Improvement of National Diet" was presented in the pages of *Science and Culture*.[159] It also prepared a detailed report of the "Symposium on Nutrition" at the Indian Science Congress Session at Hyderabad in 1937 in a joint meeting of sections of Medical and Veterinary Research, Physiology, Agriculture, and Chemistry to discuss the subject of "Nutrition in relation to crops, human beings and farm live-stocks".[160]

European had started modern investigations of Indian diets and of malnutrition from the early 19th Century. The 1920s and 1930s marked a watershed in debates about nutrition and diet in India.[161] One of the reasons why protein and nutrition became crucial was the newer knowledge of nutrition like discovery of vitamins in this period. Other factors like the absence of epidemics and famine, turned medical attention towards diet in colonial India-population growth and malnutrition emerged as the new concerns of health. Along with this was the perceived importance of India as a scientific laboratory, a 'nutrition worker's paradise", marked by its acute malnutrition which could gain much

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155 *Ibid.*, p.401.
156 *S.C.*, Vol.I., No.10, Feb.1936, p.517.
157 "Protein Deficiency in Bengali Diet", *S.C.*, Vol. ;II, No., August, 1936, p.90.
158 *Ibid.*
159 "Improvement of National Diet", *S.C.*, vol.II, No.2. August, 1936. p.
160 *S.C.*, Vol. II, No.8, Feb. 1937, p. 388.
161 David Arnold, "The 'Discovery' of Malnutrition and Diet in Colonial India", *IESHR*, Vol. 31, No.1, 1994, p.1-2.

from nutrition studies.[162] But the other major factor was the nationalist interest in nutrition as reflected from Indian newspapers, journals and public lectures of the '20s and '30s. As David Arnold has pointed out, by the late 1930s, with Indian independence becoming a distinct possibility, Indian doctors and nutritionists took up the responsibility of providing a national nutritional standard.[163] N. Gangulee, a famous nutritionist, saw in dietary reforms a way of securing the prosperity of Indian nation. He looked up to Nehru's scientism, rather than Gandhi's rejection of state-power and western science, as the only way to shake up a new India.[164] Nutrition and diet were now associated with the larger logic of a planned and industrial society.

Along with the body the mind was also needed to be ordered. Education attracted a lot of attention. *Science and Culture* was certain that education had to be now approached with a new purpose and logic,

> Time is now past when we should look upon education merely in the abstract or only as a means of imparting culture. The international competition and the struggle for existence have revolutionised our ideas. The educational resources of our country must be harnessed in the cause of its industrial expansion and development. Will the Indian universities veer round and adopt themselves to the need of the modern times or will they have to be replaced by technical institutions?[165]

Saha had prominently taken up the revitalisation of university education. As his focus was in ushering general scientific culture in India, he had identified the universities, more than the technical institutes as the centres of such a project. He envisioned a close collaboration between universities and industries, between 'pure' and 'applied' science towards a grand cultural and moral transformation.[166]

Along with education, initiatives were taken to quantify the 'Indian mind'. Standardized intelligence test of Indian boys attracted a lot of attention of the *Science and Culture*. The attempt was to develop a uniform scale and concept of

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[162] *Ibid.*, pp.16021.
[163] *Ibid.*, pp. 22-24.
[164] *Ibid.*, p. 24.
[165] "Education as a Help mate to Industry", *S.C.*, Vol. III, no. 9, March, 1938, p. 489.
[166] "Problem of Industrial Development", *S.C.*, vol.II, no.11, May 1937, pp.529-531.

intelligence test for Indian students.[167] It even appealed to the Indian Science Congress Association as well as the Indian Psychological Association to take practical steps in this regard.[168]

The broad canopy under which such a thorough regeneration was to be engineered was 'planned development'. Soviet Russia had fascinated Saha. In many of his articles, Saha expressed how Soviet Russia was the manifestation of the secular, planned scientific knowledge for national interest. He appreciated how science and state had worked together here towards a common goal. The USSR Academy of Science worked hand in hand with the USSR Supreme Council of the Soviet to organize Planning Commission and thus set on the path of planned industrialism.[169]

In one interesting instance, Saha in his Annual Address at the Asiatic Society in 1945 - 1946 recalled the famous passage from Jone's inaugural speech at the Society, given more than one and a half century ago, which expressed his sense of wonder towards Asia. Repeating those words Saha added, "Last year I had somewhat similar experiences.....I had to undertake a journey over Arabia, Mesopotamia and Iran to the mystery land of Soviet Russia, which had emerged victorious after a life and death struggle with Nazi Germany."[170]

The rest of the paper contained the description of this 'mystery' land. Soviet Russia had thus become the new in the search for an industrial society, as Asia had once been one in the other search.

But what was the political content of this appreciation of Soviet Russia by *Science and Culture*. The group has been generally seen as representing the left-

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[167] "Standardization of Intelligence Tests for Indian Boys", *S.C.*, Vol. II, No. 1, July 1936, p.57.
[168] "Editor's Response" *Ibid.*, p.48. For a history of the institutionalisation of psychology in India see D. Sinha, *Psychology in a Third World Country; The Indian Experience*, Sage, New Delhi, 1986.
[169] "Twenty - Five years of the Soviet Union", *S.C.* October 1942, Vol. 8, no. 4, pp. 145 - 149.
[170] "Annual Address, 1945 - 46" *Yearbook of the Royal Asiatic Society of Bengal, for 1945*, Vol. III, 1946, p. viii.

Nehruvian political ideology.[171] But such a characterization is rather simplistic. Saha and Nehru had appreciated the Soviet model of industrialism through different ideological motivations. While in Nehru's frame, science and industrialism were seen in relation to social, ideological and political systems within they were embedded. Saha had advocated a universalistic frame in which science and industrialism were seen in relation to their universal essence which could be discovered in all industrial systems regardless of their differences. Nehru idealized a specific form of industrialism and modernity. Saha had envisioned a more aggressive modernization where industrialism itself was seen as a dominant morality and 'culture'. Consequently while Nehru had produced a social critique of India's backwardness, Saha had explained it in terms of industrial status.

Saha's attachment with the Soviet model did not stop him from advocating this bourgeois capitalist system of United States for India. Saha was a great admirer of the Carnegie Trust of USA. He even wrote a biographical note of Andrew Carnegie to show how millionaires had contributed to the fields of science and technology.[172] In India he found in JN Tata a parallel to Carnegie. Overlooking its obvious political contradictions with the Soviet one he urged Indian millionaires to finance scientific research, "which is today largely a matter of *organization and finance*," [Emphasis mine][173]

What is reflected here is the reductionism of Saha's industrialism. In this segregation of politics from 'development', the various instances of social and economic changes became organisational issues. *Science and Culture* could now equally appreciate various models of industrial success located within different settings. Although they favoured the industrial structure of USSR, on the question of technical education, the British model with the centralised research structure

[171] This point is strongly made by Dinesh Abrol, "Colonised Minds' or Progressive Nationalist Scientist: The Science and Culture Group", in Roy MacLeod and Deepak Kumar (eds.) *Technology and the Raj*, Sage, New Delhi, 1995, pp. 265-288.
[172] "The Carnegie Educational Trusts" *S.C.*, Vol. I, No. 5, October, 1935, pp.215-218. For Saha's sympathies for the Indian capitalists like Birla, see "Problems of Indian Industrial Development in India", *S.C.*, vol.II, no.II, May 1937, p.528.
[173] "The Carnegie Educational Trusts", p.218.

and Department of Scientific and Industrial structure, appealed to them most. The editorials gave detailed picture of the scientific research organization of UK thereby making a strong case for the model of D.S.I.R.[174] The journal also published a detailed report on the "Change in Outlook of British Industry towards Research".[175] It advocated the British model where a divergence of research interest took place between the DSIR and the university in which the D.S.I.R. looked after the industrial research, whereas the universities concentrated on fundamental research, while both were being regularly reconciled. That could be done by supplementary funding of university research by industry to conduct industrial research within the university laboratories.[176] In the post-independent days, however, *Science and Culture* seemed to favour a more federal and defused research structure following the American model, particularly in agriculture - as against the CSIR and ICAR models.

The industrialism of *Science and Culture* was thus a juxtaposition of various models of industrialisation in a utopian co-existence. More than these abstractions, Saha's ideas were distinct from Nehru's in their complete disregard of the tensions of such a patch work. Saha overlooked the tension by formally expunging the political question from the industrial.

> If one surveys the different doctrines, from extreme form of imperialistic exploitation to extreme Marxism, it will be found that none is absolutely wicked or absolutely right. As a matter of fact, Russia starting from extreme Marxism is finding that some features of the old order have to be adopted faced as she is with a capitalist world, whereas even the citadels of capitalism find it necessary to introduce varying doses of government control of industry and commerce and of private property. The technique of government is tending to become similar in countries widely different in material prosperity and historical tradition, and certain controversial doctrine which are supposed to form the essential elements are not found to be so after the experience of a few decades.[177]

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[174] "Industries and Scientific". *S.S.*, vol.II, no.9, March, 1937, pp.413-416;
[175] *S.C.* Vol. II, No.10, April, 1937, pp.490-491. It paid special attention to the motto of DSIR, "research is only a means to an end. The end is the application of scientific knowledge to all stages of production and the development of new processes", *Ibid.*, p.491.
[176] "Industries and Scientific Research", p.414.
[177] "Right thinking", *S.C.*, Vol. VI, p.312.

Saha had envisioned a monolithic industrial world order. To Nehru, on the other hand, Soviet Russia was not just an organizational question, he had deeper commitment to its socialist ideologies. He had envisioned industrialism in a socialist world order.[178] He was not alone, others like the Marxist scientist, historian Damodar Kosambi too had advocated Soviet science from a complete faith in its social system.[179] He argued that a socialist social order was vital for the complete realization of the potentiality of science,

> In the USSR there are no classes, and no foreign rule. All are free to follow their natural bent, and the utmost is done to develop that bent by universal free education. The one freedom that is missing in the freedom to starve, and I may suggest, very humbly, that as long as we rejoice in that particular freedom in India, to the exclusion of all others, we shall not be able to utilize Soviet or any other science for progress and happiness.[180]

Saha's universalistic industrialism had not only precluded such political concerns but also fail to appreciate any alternative model. Saha had completely rejected the Gardhian line, unlike Nehru who had felt the need to negotiate for its social political content. Gandhi represented an alternative universalism, that of morality and truth. The questions of industrialism and science were subverted to that universalism. Gandhi's attitudes towards industrialism were thus conditioned by a critique of modernity which ignored this moral question.

Saha saw Gandhianism as a 'backward' journey and thus in very first issue of *Science and Culture* wrote, "we do not for a moment believe that better and happier condition of life can be created discarding modern scientific techniques and reverting back to spinning wheel, the loin cloth and bullock cart".[181] Saha actually saw the discourse of *Charkha* as a digression from the real needs of Indian industrialisation, "It would, however, be a pity, if this question of

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178 Chatterjee, *Nationalist Thought*, p.159.
179 D.D. Kosambi, "Soviet Science - what can it Teach us?", *Indo Soviet Journal*, Vol.2, No.13, 22 June, 1944, Collected in D.D. Kosambi, *Science, Society and Peace*, People's Publishing House, New Delhi, 1994, pp.60-67.
180 *Ibid.* p.67.
181 M.N. Saha, "Science and Culture", *S.C.*, Vol. I, no. 1, 1935, p. 2.

cottage industries diverts our attention, as it sometimes tend to do, from the major problems of industrial development".[182] Instead the attention should be, he felt, towards the application to the Indian conditions the principals of the industrial civilization of the West which was unique from all other social order.[183] Saha wanted India to choose "the cold logic of technology", not the vague utopia of Gandhian economy which to him "smacked of conspiracy".[184] On the eve of independent he reiterated the same words with which he started the venture of *Science and Culture* and short to remind his countrymen the fallacy of the Gandhian route, "in spite of what our saintly Mahatma may say, the future belongs to those who know how to use machines…".[185]

But how did these political divergences reflect upon the industrial structures forwarded by Nehru, Kosambi and Saha?

Interestingly Nehru and Kosambi as well as Malviya despite diverse political motivations had advocated large-scale industrialisation of India closely resembling Saha's plans. But in contemporary world that was not unusual. Scott shows how the three-pronged idealism of elimination of economic and social crisis, the expansion of productivity through science and the re-enchantment of technology had been acceptable to European political elite who were otherwise poles apart politically.[186] The industrialism evolved in western Europe and celebrated in the United States had actually established itself into a dominant and eventually a universal mode of industrial growth and economic regeneration throughout the world.

The Soviet route to this industrialism, illustrates how Marxism had been incorporated within bourgeois industrialism. As argued by Sanjay Seth, Marx's writings bore a two fold relationship to Enlightenment thought.[187] On the one

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[182] *S.C.* Vol. II, no. 11, May 1937, p. 53
[183] *Ibid.*,
[184] Quoted in Kumar, "Gandhi and Technology", p.433 and f.n.29.
[185] *S.C.*, Vol.13, No.2, August 1947, p.43.
[186] Scott, *op.cit*, p.99.
[187] Sanjay Seth, "Nehruvian Socialism, 1927-1937: Nationalism, Marxism, and the pursuit of Modernity", *Alternatives*, 18, 1993, pp.453-473.

hand it emerged as a part of Enlightenment thought which saw history as a progress, as a process of the emergence of reason into its own, an evolutionist view of history and a view not only that history has order and meaning but that order and meaning reside in history. But at the same time Marx had sought to produce a critique of this intellectual system. He described the Enlightenment as bourgeois thus revealing the fundamental limitation of the processes that produced it.

But Marxism lost this duality under the leading figures of the Second and Third International like Plekhanov, Kautsky, Stalin. They sought to convert Marxism into the Science of History, assuming that history was a rigid evolutionary process, governed by rigid laws.[188] Thus rather than being a critique of the inherent logic of Enlightenment, Marxism now tended accept it more closely. Evolution became a scientific process and thereby beyond critique. The bourgeois elements of Enlightenment were seen not to be inherent in it but a result of incomplete realization of its principles like reason, science and progress which were held to be the universal truths. Marxism thus became, as Seth states, "the fulfillment and true heir to Enlightenment, a knowledge expunged of its 'bourgeois' limitation and mistakes, and thus constituted as a true science".[189] At the same time Lenin was deeply influenced by both Rathenau's and Taylor's planned industrial models. Walther Rathenau had directed the German economic mobilisation during the first World War in a unprecedented scale of planned engineering. During the same time Frederick Taylor had devised a new factory system in the United States facilitating control not only over production but the entire labour process.[190] On the eve of the Revolution Lenin had declared that the 'Taylor system' would be ideal for Soviet Russia, provided that the state was in the hands of the working class.[191] Thus the Russian Revolution had to incorporate, as E.H. Carr shows, the achievements of the French Revolution and

[188] *Ibid.*, p.469.
[189] *Ibid.*, p.470.
[190] Scott, *op.cit*, pp.98-99.
[191] *Ibid.*, pp.100-101.

of the industrial revolution and to recapitulate the material advances made in the 19th Century by the west.[192] Towards this transformation of Russia into a modern industrial nation, aid and advice from the western nations including USA were freely sought and welcome.[193] In the colonies where this Marxism was adopted not as a critique of modernity but as a vehicle of national liberation, it tended further to conform to the principles of Enlightenment. This Marxism helped to consolidate a modernist and statist nationalism with the state as the instrument for industrialized social order.

Thus what Saha and *Science and Culture* propagated had general sanction. World-wide, the question of political ideologies what subverted to that of industrialism to such an extent that the formal rejections in adoption in the political question was rendered inconsequential. It was through these imperatives that the basic industrial character of the future Indian nation were ultimately determined. The task ahead was to pursue it.

Organising Industrial Research

The National Planning Committee of 1938, master-minded by Saha, although short-lived, was the first attempt on the part of the nationalist to embark on a path of systematic and planned industrialization of an independent India. Having successfully marginalised the Gandhian voice from within its deliberations.[194]

Although the planning movement was stalled due to the Second World War, the movement towards industrial research received a greater impetus during the War. This War like the first one, once again drew all attention on the need to industrialize India. It necessitated the formation of a co-ordination body for the scientific and industrial research for war requirements. To an influential group of scientists the immediate solution seemed to be the British model, on the pattern of

[192] Carr, *op.cit*, p.7.
[193] *Ibid.* p.8.
[194] Chatterjee *Nation and its Fragments*, pp.201-202.

Department of Scientific and Industrial Research (DSIR), itself formed during the first War to serve a similar purpose.[195] The efforts were recorded by politicians like the then Commerce Member, Sir Ramaswamy Mudaliar whose insistence led to the creation of the Board of Scientific and Industrial Research (BSIR, 1 April, 1940) for a period of two years. Dr. S.S. Bhatnagar, Head of the Punjab University Chemical Laboratories, was called to take charge as Director. Mudaliar became the Chairman. It was allocated an annual note of Rs. 500,000 and placed under the Department of Commerce.[196] The 'Communiqué' drawn up regarding its function replicated the Charter of DSIR drawn in 1915. It had the same function regarding advising the government for instituting specific researches, helping the study of problems effecting industries and trade, making proposals for the establishment of research studentships, etc.[197] Soon Scientist like C.V. Raman, M.N, Saha, S.K. Mitra and J.C. Ghosh were invited to join BSIR's Research Committee.

By the end of 1942, the utility of an organization like BSIR for future industrial research was becoming apparent to these men. Realising its long-term implications Mudaliar moved a resolution recommending that an Industrial Research Fund be constituted for the purpose of fostering industrial development in the country. The efforts of Mudaliar and Bhatnagar led to the constitution of Council for Scientific and Industrial Research (CSIR, 1942) as an autonomous body to administer the Research Fund created by the government.[198] Its main function according to its constitution were promotion, guidance and co-ordination of scientific and industrial research in India including the institution and the financing of specific researches; special attention to problems affecting industries

[195] "Introduction : Shaping Scientific and Industrial Research - Biographical Reflections on S.S. Bhatnagar" in V.V. ;Krishna, (ed) *S.S. Bhatnagar on Science, Technology and Development 1938-54*, Wiley Eastern Limited, 1993, pp.10-11.
[196] "B.S.I.R. at Work", *S.C.*, Vol. VI, pp.103-105.
[197] *S.C.*, Vol. V, No.11, May 1940, p.649.
[198] Krishna, *op.cit.*, p.12.

and trades; to establish, maintain and manage laboratories, workshops, institutes and organization to further scientific and industrial research etc.[199]

When the War came to an end, the question that bothered the Indian scientists and policy makers were those of organizing and financing post-independence peace-time Indian industrial research. The tilt towards the British model became further prominent when, A.V. Hill of the Royal Society was approached to advise on "the organization of Scientific and industrial research as a part of the Indian post -War reconstruction plan, and its co-ordination with the corresponding activities".[200] Hill's visit resulted in the famous *A.V. Hill Report* in 1944.

Hill's plan was generally in favour of a centralized research organization. The research agencies, national laboratories were to be constituted within the overall control of the government machinery, namely under the Member, Planning and Development. It suggested the creation of six Research Boards in Agriculture, Health, Industrial Research, Survey and National Resources.[201] A different opinion was put forward by scientists like Saha in the National Institute of Science Symposium which argued for more political autonomy for the CSIR.[202] Hill's report sought to place it under the control of Central Government like the DSIR which was directly answerable to the British Parliament. The NIS Symposium endorsed the idea of the constitution of a National Research Council (NRC) mainly outside the Control of government machinery but accountable to the Government of India.

In the years leading to independence when question of choice became imminent, there was a sharp debate between Bhatnagar and Saha on this question of organization. Bhatnagar emerged successful endorsing Hill's report which recommended centralization of all research under a single Government

[199] *Ibid.* pp.12-13.
[200] A.V. Hill, *Scientific Research in India*, William Chowers and Sons, London, 1944.
[201] *Ibid.*, pp.41-42.
[202] The scientists included were J.C. Ghosh, M.N. Saha, K.G. Naik, S.S. Bhatnagar, B.C. Guha, P.C. Mahalnobis in Krishna *op.cit.*, p.25, footnote 57.

Department. S.S. Bhatnagar thereby became the first Director of the CSIR in independent India.[203]

A strong scientific elite backed by the political leadership thus articulated independent India's industrial research. The state was the major supporter of scientific and industrial research. The policy was to reflect national goals through industrial research, fitted within the broader trajectories of planned economy. The stress towards forced industrialization in this planned logic, put CSIR in a unique position as the institution to motivate such a process. In 1950 six prominent CSIR laboratories were inaugurated - The National Physical Laboratory, National Chemical Laboratory, Central Fuel Research Institute, Control Glass and Ceramic Research Institute, Central Food Technology Research Institute and National Metallurgical Laboratory. This was in conformation to the Nehruvian planned economy to be organized around "the temples of science". M.N. Saha, who was increasingly sidelined in these developments decided to have a separate institute for nuclear physics, to be carved out of his department at the University of Calcutta. The Institute was formally inaugurated in 1950 and named the Saha Institute of Nuclear Physics, after his death.[204]

Searching for an Industrial Society

Having thus established the national laboratories, India had thus formally taken the first strides towards an industrial society. On the eve of independence, *Science and Culture* had reminded its readers that the task ahead was difficult but the only way to receive the political turnover. To Saha this political independents implied a technological revolution:

> To gain freedom and retain it are two vital but distinct phases of collective efforts. *Science and Culture* has spared no plans to preach that the only way to achieve the full objective is to achieve a Technological Revolution in our methods of living and work. This

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[203] *Ibid.*, pp.15-16.

[204] Robert S. Anderson, *Building Scientific Institutes in India : Saha and Bhabha*, Occasional Paper Series, No.11, Centre for Developing Area Studies, Manheal Mc-Gill, 1975.

> alone can render the Political Revolution which has culminated in Independence worth anything.[205]

Independence offered the scope for a greater thrust towards industrial modernization. By the end of World War II, with the decolonisation process in full swing, modernization models based on and compatible with the metropolitan economies were getting widely articulated. They were invariably based on the assumption that the industrialization was essential for the full development of a non-industrial nation. Social Science Research Council of USA to formulate a broadly comparative and global model of social analysis launched a major effort. Such an analysis, incorporated the neo-Darwinian concept of natural selection, the Weberian notions of social action and the Marxist idea of a progressive, rationalized and secularized society.[206] In such a modern world the pivotal role was to be played by applied science and technology.[207] These views were supported and reiterated by the political elite of the newly independent states. Independent India's choice for such a world has to be seem in the light of this emerging consensus formed as much within India as it was generated from the metropolitan economies.

In a brief study of the CSIR laboratories, I would like to see how independent India's scientific research sought to conform to that world view.

The R.K. Shammukham Chetty Committee of 1945 had provided certain basic priorities of CSIR research. The priority would be, not only to protect Indian industries from foreign competition, but also the development of new industries which had a large scope in India. It also suggested the formation of a National Research Council, to formulate a comprehensive industrial plan which would facilitate CSIR research.[208] The First Review Committee (CSIR) of 1949 (when plans for establishment of national laboratories were getting ready) made a

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[205] "Twelve Years of Science and Culture", p.1.

[206] Fred Dallmayr, "Modernization and Post Modernization: Whither India?", *Alternatives*, 17, 1992, pp.423-424.

[207] There views were supported and reiterated by the political elite of the newly independent states.

[208] *Sir R.K. Shammukham Chetty Committee Report, 1945 (CSIR)*

number of important recommendations. It stressed that the greater part of activities of the Council should be devoted to problems of research which could be directly applied towards industrial development of the country. It emphasized, on the American lines, for the proper representation of the Council in trade association, chambers of commerce etc. To that effect it recommended the appointment of an Industrial Relation Officer. To publicize and familiarize industry with the Council's research, the need for industrial museums was also stressed. Another suggestion was that in order to make researches of the Council of immediate practical benefit to industrialists, they should be carried on as far as possible to the pilot plant stage and for that purpose, adequate provisions for pilot plants should be made in the National Laboratories and elsewhere.[209]

But how far did the formation of CSIR on such a massive scale and planning usher the industrial society that was visualized in the decades proceeding this? In many ways it illustrated precisely the problems underlying the realization of that vision. By the 1950s there was a strong feeling that the laboratories were falling short of industrial needs. Initially pointed out by the *Science and Culture* , the Special Committee (CSIR), of 1954, farmed to examine the recommendation of the Second Review Committee (CSIR), accepted it. It felt that the National Laboratories fell somewhere between the development research laboratories and the fundamental research institutes and did not fulfil the function of either. It generally saw the problem as lack of orientation and thus suggested that research workers should be deputed to factories in order to make themselves aware of the processes involved in the industry.[210]

The *Third Review Committee Report* (1964) agreed that there was in fact a need to re-orient the research programmes in the laboratories.[211] But it also hinted that the lack of useful researches in the laboratories had a larger backdrop. It pointed

[209] *Report of First Reviewing Committee ; 1948*, CSIR, pp.30-34.
[210] *Report of the Special Committee of the Governing Body of the CSIR*, CSIR, New Delhi, 1954, pp.4-13.
[211] *Report of the Third Reviewing Committee of the Council of Scientific and Industrial Research*, New Delhi 1964, p.219.

out that Indian industries lacked the spirit of change, the urge to try out new technologies of the laboratories and continued to depend on the old techniques which had become obsolete in the contemporary state of industrial research. Such a situation existed because, the report pointed out, the Indian economy did not produce enough pressure towards either cost reduction or quality improvement. The economy provided a sheltered market which had made Indian industries lack competitiveness and progressiveness. In such an atmosphere industry would basically not be interested actively in research. The Committee thus debated on various ways to provide industry with incentives to start their own research or undertake research results of CSIR within this framework.[212] The logic of industrial science now required a larger structures of Indian economy to adjust to it.

In 1964 CSIR felt the need to ask the United States AID Mission for technical assistance in the form of equipment, fellowship, and expertise. In response, a Committee of the Battelle Memorial Institute was formed to inquire into the existing situation of industrial research in India.[213] This report pointed out the larger attitudinal changes required to be brought about both within to usher a new industrial ethic within the country in the laboratory and outside. On the part of the laboratory, it found the personnel significantly lacking in industrial experience. Having come directly from some academic institutions into the laboratory environment, they did not share the vernacular of the industrialists. The report concluded that technical training in India had to be reoriented.[214] On the other hand, the industries of India had little appreciation of science. The Committee pointed out that most Indian industrialists were lacking in experience with scientific research. Their education were typically of a "classic liberal arts type", and they were frequently found to be the "scion of long established families" which had historically dominated the Indian industrial scene. The

[212] *Ibid.*, p.22.
[213] *Final Report on A Study of Selected Laboratories and Department of the Council of Scientific and Industrial Research, Govt. of India*, by The Mission to India of the United States Agency for International Development, New Delhi, July, 27, 1965.
[214] *Ibid.* pp.34-35.

committee preferred younger men with technical backgrounds to become entrepreneurs.[215] In the Government agencies which could also co-operate with the laboratories, the committee saw the remains of the days of British Raj when the management - oriented company was the norm rather than the technology-based one.[216]

The *Science and Culture* had also sustained its search for a modern industrial society. The thrust of the argument being that the monopoly of industrial research in the grand laboratories of CSIR and the subsequent neglect of universities narrowed down the field of industrial orientation of general education. As early as 1948, the editorial of the journal expressed its apprehensions that big laboratory plans would overshadow university research. It questioned asserted that universities had an important role to play in achieving Indian industrialization and held the CSIR as well as the UGC responsible to encourage different universities and other institutions to submit schemes for grant-in-aid research.[217] Saha as a Member of the Parliament from 1951 had launched a strong critique of the government educational policy, particularly on the neglect of universities. He took a leading role in the debate on Demand for Grants for the Union Ministry of Education as well as the University Grants Commission Bill. The thrust of his argument was to show that in the great plans to build a model industrial India, university education was being ignored. Such an impoverished university structure could not "produce the right type of men who can build this country. We are, therefore, running to disaster".[218] Referring to the National Laboratories, he pointedly remarked,

> You have erected a temple, but you have not made any provision that there should be a constant influx of trained votaries into the temple. There would be no life in the temple. If you want to instill life into this country, if you want to trained a band of workers for the great work of

[215] *Ibid.* , p.34.
[216] *Ibid.* p.46.
[217] "Department of Scientific Research", *S.C.*, Vol.14, No.2, August, 1948, p.44.
[218] "Motion on Address by the President Amendment: May 20, 1952", in Santimay Chatterjee and Jyotirmay Gupta (compiled and edited) *Meghnad Saha in Parliament*, The Asiatic Society, Calcutta, 1993, pp.8-9. Also see Saha's "Debate on the University Grants Commission Bill: November, 1955", *Ibid.*, pp.18-39.

> reconstruction which has been the dream of all our national leaders, I would appeal to you that this policv of indifference, this policy of denial, be not allowed to go on...[219]

Similarly the *Science and Culture* in next few years was repeatedly pointing out that the neglect of basic research in the universities would ultimately dry up industrial research in the country. In 1951 its editorial pointed out that more attention to basic and secondary education world raise the technical aptitude of the people. It warned that a neglect of that would result in a dearth of efficient workers to man the laboratories in future.[220] At another occasion the editorial of the journal pointed out that pure science formed the undisputed basis for all applied arts and engineering.[221] The industrialisation of India thus could not afford to ignore university research. J.N. Mukherjee in his Sixth Acharya P.C. Ray Memorial Lecture in 1953 rejected the charge that university researches were not of much use in tackling practical problems facing industry and agriculture.[222] He pointed out that industry and agriculture were making very little use of university men:

> Theory and practice must go together....An effective link between the academic research and the problems of industries is necessary. One of the important developments in recent years in USA and UK and other countries is research in the universities sponsored by industries and Government Departments.[223]

Mukherjee pointed out that although CSIR had been built up on the pattern of its counterpart in UK. but one of the most essential links of the British organization was missing here. Those were the research associations and their

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[219] "General Budget- Demand for Grants for Ministry of Education-Cut Motion : June 13, 1952", *Ibid.*, p.17.
[220] "Manufacture of Scientific Instruments of India", *S.C.*, Vol.17, No.10, April 1951, pp.435-441.
[221] Ajay Kumar Bose and Tuhin Kumar Roy, "Some thoughts on HIgher Technological Education "*S.C.*, Vol. 16, No.11, May, 1951, pp.497-500.
[222] J.M. Mukherjee, "Development and Utilisation of Scientific Talent in India", *S.C.*, Vol. 21, Oct.1955 pp.198-200.
[223] *Ibid.*, p.199.

laboratories, which were maintained by funds contributed by industries in a particular field.[224]

In the years after independence, following Saha's estrangement with the CSIR, the *Science and Culture* became increasingly apprehensive about the policies of large scale industrialisation. Once a vociferous advocate of large scale industrial research the journal now felt the need to produce a critique of technical institute, much the same way as Ray did, using unwittingly the same words, "the construction and organization of these splendid modern laboratories at the present stage of India's industry is the better than putting the *cart before horse....*"[225] (Emphasis mine). The search for an industrial India thus continued. In fact it was just the beginning when the politics of models had learnt how complicated the social and economic realities were.

Conclusion

The attempt here has been to delineate the evolution of a certain pattern of industrialism in colonial India. This history is relevant to our general understanding of science in modern India to the extent that science and technology were closely linked to that evolution. Here we come back to the problem with which we started this chapter- from the link between the two projects around science. The history of this industrialism in colonial India was distinctly shaped by the search for cultural and historical roots within science. For example, despite distinct definitions, science to both Sircar and Ray represented man's triumph over nature, a promise for a new social and economic order, the essential materialism that India lacked or had lost. These had remained the basic inspiration for that industrialism. In turn, industrialism shaped the search for cultural legitimacy of science as well. In industrialism science had found a more powerful vehicle for its legitimacy. The other project of cultural

[224] *Ibid.*
[225] "Report of Second Reviewing Committee (CSIR) [Editorial]" *S.C.*, Vol.20, No.8, Feb. 1955, p.354.

roots now lost its thrust and was gradually marginalised in the nationalist discourse.

This idea of secular industrialism has been so imposing that even recent histories of Indian industrialism do not focus on the other project at all. Shiv Viswanathan's book, brilliant as it is in its analysis and empiricism, tries to write a distinct history of industrial research from the days of Asiatic Society down to the CSIR laboratories. The moral and cultural frameworks within which science was being located, does not figure in it. The assumption being that an insulated, distinct history of industrial research did exist. It thus seeks to locate industrial research and its problems within its own logic. A better understanding of the problem needs the appreciation of the larger context.

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