WESTERN SCIENCE IN BRITISH INDIA ; ORIGINS, DISCOURSES AND LEGITIMACY, 1780-1860

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CERTIFICATE

This is to certify that the dissertation entitled, **WESTERN SCIENCE IN BRITISH INDIA ; ORIGINS, DISCOURSES AND LEGITIMACY, 1780-1860**, submitted by **Pratik Chakrabarti** for the degree of Master of Philosophy has not been previously submitted for any other degree of this or any other University. We recommend that this dissertation be placed before the examiners for their consideration for the award of M.Phil. degree.

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To
Choto Mama

"A man may be attracted to science for all sorts of reasons. Among them are the desire to be useful, the excitement of exploring new territory, the hope of finding order, and the drive to test established knowledge".

Thomas S. Kuhn,

The Structure of Scientific Revolutions.

CONTENTS

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P Chakrabarti

PRATIK CHAKRABARTI

INTRODUCTION

The introduction of Western Science in India accompanied the assertion of British Imperial dominance in the 18th and 19th centuries. The discussion of this origin has to consider not only the logic of Imperial dominance in India but 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 seventeenth 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.

The seventeenth century was characterized by a philosophical revolution in which teleological explanations of natural phenomenon were replaced by explanations in terms of mechanical laws, in which the hierarchical closed world of medieval cosmology was replaced by the concept of an infinite universe with a unified physics and astronomy grounded on the mathematical, mechanical physics of Newton. The new science of the seventeenth century was describe by E.J. Dijksterhius as "the mechanization of the world picture" which "meant introduction of a description of nature with the aid of the mathematical concepts of classical mechanics".[1] It culminated in the Newtonian synthesis of mechanics and astronomy, where nature was conceived as a law governed system in which God's relation to nature was viewed merely as a first cause, and the appeal by scientist to laws of nature established knowledge of nature as independent of divine providence.

By the late eighteenth century the activity of science 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 'scientist', the professional investigator of technical problems. The term 'scientist' was actually coined by William Whewell at the 1834 meeting of the British Association for the Advancement of Science, as the traditional term 'philosopher' was regarded as being "too wide and lofty a term".[2] 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 mergence and consolidation of newly defined and specialised scientific disciplines. 'Natural philosophy' and 'natural history' were gradually transformed into 'Physics', 'Chemistry', 'Biology' and 'Geology', each having its distinct boundaries, subject-matter, conceptual structure, technique of investigation and trained, specialised practitioners.[3]

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[1] E.J. Dijksterhiuis, *The Mechanization of the World Picture*, OUP, Oxford 1961.

[2] Peter M. Heimann, "The Scientific Revolutions", in *The New Cambridge Modern History*, XIII, Companion volume, edited by Peter Burke, CUP, 1979,p.250.

[3] For further details see Heimann, *op.cit.*

The specialisation of scientific activity was accompanied by increasing opportunities for the pursuit of a scientific career and the wider availability of scientific education in Europe. In the 18th century science prospered in the universities as an appendage to medical education, and was firmly established at a few universities such as Edinburgh and Leiden which had important medical faculties. The 19th century saw the further specialisation of courses in French and German and later English universities. This was accompanied by the emergence of science as a socially-organised intellectual enterprise. In early 19th century Britain, there was a dramatic institutional expansion of science. In the course of the period 1780-1830, a burgeoning of scientific institutions took place in Britain, mainly voluntarily supported and devoted to the cultivation of specific scientific specialisation. A plethora of specialised societies, devoted to geology, minerology, astronomy, Zoology and engineering, proliferated and flourished, and 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 patronise research by its meetings and research grants, and setting the agenda of scientific research in Britain and in other distant parts of the earth.

The introduction of western science took place in India during this professionalisation and specialisation of the discipline in Europe. The thin and sporadic flow of European medical men, naturalists, jesuit missionaries and adventurers with varying degree of scientific background which had started a century earlier, developed by the end of the 18th century into a steady and regular stream of scientists. They came as company officials and administrators but were also involved in surveys of all possible scientific interests - botany, minerology, geology, zoology, meteorology etc. Training in Europe as medical practitioners had introduced many of them to the scientific curriculum of contemporary European universities. Through their researches in India, some of these men acquired eminence, being elected Fellows of the Royal Society of London.

Much like Europe, scientific societies came up in colonial India since the late eighteenth century. The Asiatic Society of Bengal (1784) was amongst the first to be established closely followed by the Botanical Garden at Calcutta in (1787) in the pattern of 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 opened at Calcutta, Madras and Bombay. The Madras Literary Society was founded in 1818.

My research focuses on this period when scientific researches were started in different parts of the country. Like Europe, scientists here tried to organise themselves in clubs and societies, and sought to draw up plans and programmes for their research. In this early period the government took little or no interest in scientific surveys and the scientists carried on their researches on their individual initiative. The interest of the colonial state and that of science remained very different. The history of modern Indian science ignores those individuals who worked in different parts of the country in these early colonial years. I hope to retrieve an important period of Indian scientific experience and to establish these men as important actors in the Indian history of science. My discussion comes to an end by the 1860s because after that the nature of scientific research underwent some significant changes. By this time gradually scientific activity was on a more organised scale. The government started taking direct interest and organised the different departments. The existing works on science in the empire have analysed this later period much more comprehensively. The scientific societies of England often in the early years acted as parent bodies to their Indian counterparts providing guidlines, informations and instructions for scientific researches. The Asiatic Society closely followed the developments in Europe and set the research agendas on the pattern of those suggested by the Royal Society. The British Association for the Advancement of Science played a central role in providing instructions. This early period (Banksian Era) saw the high point of metropolitan scientific institutions in becoming suggestive and instructive about scientific efforts of of European scientists engaged in the colonies.[4]

<u>The Question of Legitimacy</u>

Since in this early period scientific research agendas in non European countries

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[4] Named after Sir Joseph Banks (1743-1820), the long time President of Royal Society. Endowed with enormous private means, he was devoted in promoting and patronizing natural science research in the colonies.

were largely shaped from Europe, the general historiography of science in the colonies has looked upon these scientific activities from a centralist metropolitan viewpoint. It represents the scientific work in the colonies as simple data - gathering by 'second-rank academics' who carried through assigned tasks. The model was first chalked out by Donald Fleming in 1962 for studying American and Australian experiences with western science.[5] It was further developed and universalized by George Basalla by his three phase model. He thus provided the theoretical basis for the spread of what he called 'colonial science'.[6]

However, there is another approach which looks at the scientific activities in the colonies in a different way. Writing in the 1960s, Edward Lurie, A. Hunter Dupree and I. Bernard Cohen stressed the scientific genius of the colonial personalities.[7] Although Ray Macleod, accepts the term 'colonial science', he is not ready to approve of Basalla's model as a unilateral transfer of western scientific ideas, experiences or theoretical propositions from the metropolis to the colonies. As Macleod says, "New information, drawn from the colonies, was used to support European theoretical

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5 Donald Fleming, "Science in Australia, Canada, and the United States: Comparative Remarks", *Proceedings of the Xth Congress of History of Science*, Ithaca, 1962.

6 George Basalla, "The Spread of Western Science', *Science*, Vol. 156, 1967.

7 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, 1956.

positions, whether concerning race, the structure of the earth, or the mov heavens. Colonial science ... may paradoxically hold a vital and not a su position, as seen by disinterested parties". Macleod raises certain important questio whether the empire was important to metropolitan science! whether colonial scientists appreciated their importance; and if so, whether they did anything about it. From the "centre" how did the centre actually deal with the new insights available only from the periphery?[8]

The importance of the periphery to scientific research in the metropolitan centre is difficult to analse because of the inaccessibility of European scientific texts and debates of that period. Such a study would also shift the discussion to philosophical issues in the history of science which I am neither capable nor confident of tackling at this stage of my research. In the debates between Imre Lakatos and Thomas Kuhn on the role of criticism on existing scientific knowledge and theories, Imre Lakatos argues along a positivist line that criticism forms a major part in falsifying existing theories and thus in progress of scientific knowledge. For Kuhn, who described the nature of scientific revolution through his argument of paradigm shift, sees the role of criticism differently. Criticism of existing knowledge, according to Kuhn, remains rooted to the premises of the existing scientific paradigm and only strengthens the paradigm by finding newer ways of coming to expected conclusions. A paradigm shift occurs only

8 Roy M. MacLeod, "On Visiting the 'Moving Metropolis': Reflection on the Architecture of Imperial Science", *Historical Records of Australian Science*, 5,3, Canberra, 1982, p. 6.

when such criticisms cannot be explained by the paradigm thus causing a 'crisis'.[9] The contradiction is thus engendered in a single point. Lakatos arguing criticism advances knowledge by sophisticated falsification and Kuhn arguing that it either confirms or contradicts established knowledge. It would be important to analyse whether research and debates in the colonies led to any transformation of western scientific knowledge, whether there was any paradigm shift in any sense of the term, or whether there was only affirmation and elaboration of existing knowledge. Such questions, cannot be addressed within the framework of my study. I would however, seek to understand how researches in the colonies questioned western scientific theories.

The works of Edward Lurie and Macleod on this have generally concentrated on United States and Australia. The history of the South Asian experience of colonial science is yet to break out at the centralist viewpoint and develope an alternative approach to the question of legitimacy of science in the colonies.

The approach here, however, would be significantly different from that of Lurie and Dupree. I feel even the question of 'scope' and 'genius' of scientific activity in the colonies cannot be fully and objectively assessed without closely studying contemporary developments in Europe, and to this sort of sources I do not have access. But without this assessment the search for legitimacy has the danger of becoming an over-glorified

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9 Thomas S. Kuhn, "Reflection on my Critics", and Imre Lakatos, "Falsification and the Methodology of Scientific Research Programmes", both in Alan Musgrave and I.Lakatos eds., *Criticism and the Growth of Knwoledge*, CUP 1978. Other articles in this volume are also important.

story of scientific activities in non-western world.[10]

This thesis is primarily based on a close scrutiny of various research papers published by scientists in India in the various journals. The editorials of these journals were very interesting and provide insight into the convictions, aims and ambitions of the scientists. The journals like *Asiatic Researches, Journal of Asiatic Society of Bengal, India Review and Journal of Foreign Science and Arts,* published the proceedings of the Asiatic Society regularly which gives a broad idea of the nature of discussions on science taking place there. I also study a number of books written by these scientists on various scientific subjects. This provides an interesting insight to the questions of legitimacy and the scope of colonial science. Did the scientists think that they were 'mere collectors of data', or did they see themselves making fundamental contributions to human knowledge ? Did the scientists try to test the scientific theories of Europe ? If they did, which theories were tested and why ? How did they look upon their own works and achievements ? When faced with indifference from Europe, how did they argue for the importance of their researches?

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10 However, I cannot resist mentioning that Paul Feyerabend has shown that in the realm of science people considered to be 'outsiders' by the close scientific community or 'dilettantes' have often pointed out some of the major mistakes committed by the established scientists. See Feyerabend, *Science in a Free Society*, Verso, 1978.

State, Commerce, Colonialism

The positivist philosophical tradition of 19th century Europe, saw in science the basic elements of enlightenment. In their writings the history of science appeared as the history of progress, a history of the continuous unfolding of scientific thought from the past to the present.

The assumptions of this 19th century framework have been criticised in the 20th century. Several questions have been asked: is history of science a history of continuity? Can we operate with the idea of progress in the writing of the history of science ? It is from this critical assessment of modern science that its relationship with the state has been analysed to a great extent. Thomas Kuhn, who argued for breaks in the history of science and located the arbitrariness and irrationalities of scientific theories in the sociology of science, threw some important light on this question.[11] According to Kuhn, scientists enjoyed a peculiar insulation which secured them from any regular social interrogation. This was because the choice and rejection of any theory depended on the consensus among the scientists. The apparently objectified, nature-free character of modern science facilitated such an insulation. It could be used against all forms of social norms, to violate every custom and yet remain supreme because it had the mask of rationality and progress.

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11. Kuhn, *The Structure of Scientific Revolutions*, The University of Chicago Press,(1962), 1970. However, many of his arguments were influenced by the French philosopher, Alexander Koyre. Read Koyre's "Galileo and the Scientific Revolution of the seventeenth century" and "Galileo and Plato", in Peter Redondi and P.V. Pillai edited, *The History of Science: the French Debate*, Orient Longman, New Delhi, 1989, pp. 105-117, 123-141 respectively.

Charles Coulston Gillispie's work studied the relationship between the scientists as a community and the French state of the late 18th century.[12] The scientific community, according to him, maintained a very professional relationship with the state. There was a mutual dependence in the sense that the statesmen and politicians wanted instrumentalities, from science : weapons techniques, information, communication and so on. The scientists, in return, wanted support in the obvious form of funds, in the shape of institutions, and in the constitution and recognition of their professional status.

Quite similar to Kuhn, Gillispie also argues that the scientists as a group, unlike artists, writers and social scientists, are free from any sort of political, social or ideological bias. He goes on to locate dangers of such an isolation. The scientists alone, his argument goes, are pressed into the service of each regime, quite without regard to political distinctions between liberty and tyranny and they received returns in the form of increasing institutional benefits from each government.

Paul Feyerabend in his discussions on science and the modern state has carried this critique even further. He argues that modern science by delegitimising all other traditions of knowledge enjoys an absolutist power and total state patronage.[13]

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12 Charles Coulston Gillispie, *Science and Polity in France at the End of the Old Regime*, Princeton University Press, Princeton, New Jersey, 1980.

13 Feyerabend, *Against method; Outline of an Anarchist Theory of Knowledge*, Verso, London, 1975.

According to Feyerabend, this power of absolutism has supplied western states the power it needed to suppress the non-western world, not only physically but also by robbing them of their intellectual independence by forcing them to adopt various 'scientific' values and traditions. In my discussions on how modern scientific knowledge, called 'new science' by the scientists delegitimised the traditional forms of knowledge, and also on the insulation of the scientists from the social world I have largely depended on this tradition of writing particularly that of Kuhn and Feyerabend.

Following closely on Kuhn's and particularly Feyerabend's critique a trend of writing on science and the modern state has developed in India. The writings of Ashis Nandy, Claude Alvares, Shiv Viswanathan and others have criticised the various ways colonisation and western science has led to the destruction of traditional sciences in India.[14] They reflect a strong critique of the whole issue of modernity and western science in the third world countries and highlight the power of traditional knowledge.

These writings are however not dealing with the history of science in the colony. They are actually a critique of the post-colonial state where the discussions on the colonial state and science only come as a background. Thus their discussion on the colonial state and science is rather superficial and tends to suffer from their total preoccupation with the present state.

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14 Ashis Nandy, "The Traditions of Technology," in *Alternatives: A Journal of World Policy*, Vol. IV, No. 1, July 1978.
Claude Alvares, *Science, Development and Violence The Revolt against Modernity*, OUP, Delhi, 1992.
Shiv. Viswanathan, "From the Annals of the Laboratory State", in *Alternatives: Social Transformation and Humane Governance*, Vol. XII, No. 1., January, 1987.

There is another form of historiography which only concentrates on science in the colonies but operates within a different framework. It does not criticise modern science or its introduction in the non-western world, it rather criticises only the process of colonisation through science. It has a faith in western science but criticises the way it was used as a tool to colonise. Deepak Kumar, one of the pioneers in the study of science in colonial India, assumes that science was closely associated with the colonising process. Thus he writes "Both (Science and Colonialism) moved together, hand in hand and had a close cause - and - effect relationship".[15] Satpal Sangwan's history of science in colonial India begins in 1757 and ends at 1857, both very important dates in the colonisation process of India.[16] These works locate the nexus between science and imperialism in the different scientific surveys. They demonstrate how the apparently scholarly researches on Indian topography, geology, botany were guided by narrow commercial and administrative factors. A basic assumption of these works is that western science in the colonies had only commercial implications.

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 alongwith them on their forays overseas. But was science implicated in the imperialist project at

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15 Deepak Kumar, "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, p. 51.

16 Satpal Sangwan, *Science, Technology and Colonisation; An Indian Experience, 1757-1857*, Anamika Prakashan, Delhi, 1991.

a deeper level, as an active component in the panoply of economic imperialism ? Was the 'empire of reason' a willing adjunct of the empire of political domination and economic exploitation ? More interestingly, is there evidence of this in the actual texts of the science done in the colonial lands ? Was a malign imperial presence lurking behind the data and inevitably colouring its collection and interpretation ?

The present research through its study of the attitudes of scientists involved in such researches would show that the practice of science had much more complex issues at stake than imperialism. It would serve 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.

It is in this regard that my period of study becomes very important. As I have mentioned earlier this early phase showed certain interesting characteristics for the relationship between science, colonial state and colonialism. I would illustrate that in this period of largely amateurist individual pursuits scientific researches were not done only for colonial and imperialist purposes. It was largely an extension of the European metropolitan project of codifying data about the natural world. For example, in botany the scientists in India, including Jones were largely involved in Linnaeus's project of organising species into a coherent plan. On my chapter on geology, I have shown how different theories of Europe about geological evolution were tested in India. Many such theories had little commercial value and were carried out totally on individual initiative. Neither had they anything to do with the cultural, economic and political grid of imperialism, atleast the scientists who concieved of and carried out these researches often showed no links with the state. Their interests, clearly, were different. Infact they complained against the government for its preoccupation with commerce and thereby its neglect of pure research in science.[17] This certainty changed by the late 19th century when the govt. realised the benefits of scientific researches and took direct interest in it. That was probably because by the late 19th century the very nature of the colonial state and the question of resource mobilisation had changed. Thus one important argument that this research would like to make is that during the early periods when western science was introduced in India, the interests of the colonial state and the scientific community were rather different. It is too simplistic to argue that western science was introduced in India as an appendage of colonialism.

Having said this I would like to point to a problem of terminology with most of the writings on science in the colonies. That is the use of the term 'colonial science'. The term largely stylised by Basalla was taken up by others without exception. Even MacLeod inspite of his brilliant theoretical discussions goes back to this term to denote science in the colonies. I have mainly two strong objections against such a usage.

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[17] This is not to suggest that the scientists were not conscious of the phenomenon of 'imperialism': some of them devoted their efforts directly to the process, others atleast took a pride at the British domination of the world. The point I want to make here is that the particular insulation of the scientists from the social and political changes and the fierce committment towards their discipline, as discussed by Kuhn, allowed them to see beyond imperialism and to think of 'benefits' from possessions in purely scientific terms.

First, such a term narrows the scope of science in the colonies to very specific politico-economic connotations. Deepak Kumar titles one of his articles - "The Evolution of Colonial Science in India". This term defines science in narrow terms and does not allow the assessment of other dimensions. As I have already mentioned, my research would be largely an attempt to look at these 'other' perspectives.

Second: the differences between various traditions of sciences are basically methodological.[18] Thus only geographic, or political connotation attached to a particular form of science does not signify much if that does not denote any methodological distinction. Thus one would also argue against terms like 'British Science', 'French Science', or even Nationalist Science, but not Chinese Science or Western Science, which signifys different methodologies. This is to further stress that modern science, even in colonial India largely remained a western discipline. The colonial context added certain features to it but did not change its framework. My intention here is to trace the origins of western science in India.

This is why I have avoided the term 'colonial science' throughout my dissertation. The lack of a suitable alternative was a problem, and I was unable to coin one. Phrases like 'western science in colonial India' etc., which I use has made the reading tedious.[19]

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18 That is between Aristotlean, Copernican, Ayurvedic, Yunani etc.

19 I once thought of 'science in periphery' vis-a-vis metropolitan science, but rejected it as it would strengthen the centralist metropolitan viewpoint which I am not totally convinced of.

My arguments are largely divided into two sections with two chapters each. The first two chapters study the attitudes of the scientists: their aspirations and hopes, their attitudes towards the colonial state, western science in general and their own work. The next two chapters concentrate on two particular sciences - meteorology and geology.

My choice of these two particular sciences are primarily for two different resons.

Meteorology as a science has been generally neglected by scholars writing on Colonial Indian History of Science. I am yet to come across a piece of literature which deals particularly with this field. This is all the more surprising because meteorology occupied a very significant place in the discourse of science in colonial India. As I have shown in my chapter the scientists showed particular enthusiasm about the unique facilities offered by tropical India for such climatic studies. It is because of this lack of existing historical analysis of this discipline that I have had to make my own formulations regarding its scope and significance in colonial Indian scientific discourse. I have tried to see how the climate of India became a part of scientific interest for the British scientists, what concerns motivated the surveys in different branches of this science.

Geology on the other hand does not suffer from this neglect. It is infact one of most discussed sciences of colonial India. The discussion, however, have tended to be one sided - stressing the commercial dimension only. But geological surveys were not only about coal and other minerals. It also included detailed paleontological and different rock formation surveys which make the whole issue complicated. My attempt here has been to link up these studies with the contemporary philosophical developments around this science in Europe. Not negating the commercial and colonial factors, I have tried to see what inspired Cautley to study the Siwalik fossils and Newbold to extend the study of 'Glaciation Theory', developed in Europe, to South Indian rock structures.

PART - I

SCIENTISTS IN THE COLONY

CHAPTER I

Colonial Scientists and the Metropolitan Knowledge.

> Bringing a normal research problem to a conclusion is achieving the anticipated in a new way, and it requires the solution of all sorts of complex instrumental, conceptual and mathematical puzzles. The man who succeeds proves himself an expert puzzle-solver, and the challenge of the puzzle is an important part of what usually drives him on.
>
> \- Thomas S. Kuhn.[1]

This chapter will study the attitudes and beliefs of those British scientists who were engaged from the last two decades of 18th century in various scientific researches in this country. It would attempt to see how these scientists conceived of the role they were playing in the colony in the constitution and transformation of metropolitan scientific knwoledge. The existing historiography has failed to give proper attention to this issue. The major problem with that historiography, as I have mentioned before, is that it sees introduction of western science in India as merely an extension of the commercial colonial project. Thus the scientists seem to be mere puppets in that great project, serving only pecuniary interests. Such an attitude leads to a pre-conception that a career made in the colonies was bound to second rate, without any scope for 'pure' research. It is, however, a fact that numerious educated Europeans started their scientific careers in the colonies - India, Ceylon, British Malaya, Burma and some of them retired in the metropolis with recognition and their respectful placing in the

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1 Kuhn, *The Structure of Scientific Revolutions*, *op.cit.*, p. 36.

growing group of new scientists there. It is they who organised the various scientific clubs in the colonies in specialized branches of science during their stay in the colonies. On their return to the metropolis some of them became prominent scientists. Many British scientists with colonial backgrounds became members, secretaries, vice-presidents of the leading scientific societies of Britain.

This chapter would like to go beyond this focus on commercial colonialism without, however, denying it. It intends to study the sort of researches that the scientists carried out and their attitudes towards their research. What did they think of the discipline called 'Science' which they served ? What did they think of the work they were doing in the colonies ? What were their ambitions and beliefs ? What were their attitudes towards the metropolitan scientists since their works were often treated as 'low sciences' by those back home ? The attempt would be to study some of the complexities in their thinking towards their discipline and also to reconstruct the orientations of these men who have been either overlooked forgotten.

The Individuals

To begin with it would be interesting to do a brief biographical study of these men. What sort of training or education did they receive ? What were their experiences in India and England and how did they begin their researches ?

One striking fact about these men is the richness and variety of their experiences. One common aspect for some was that they graduated in medicine from England and then joined the army in India. This is not surprising because in the 18th century and early 19th century England, science prospered in Universities only as an appendage to medical education. Hugh Falconer who was internationally recognised for his paleontological discoveries was born in 1808 at Farres, north of Scotland. He recived the degree of Master of Arts at Aberdeen and in 1826, he proceeded to Edinburgh to study Medicine and also followed up his interest in Natural History by studying botany and geology. After getting his 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 Irrawaddi 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. Gradually he was placed in the Siwaliks and then in the higher Himalayas. It is here that Falconer collected for years fossils which made significant contribution 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 those few scientists who started and spent a large part of their scientific careers in a colony and gained high respect in England. Once he went back to England, he was a member of the Geological Society and read many papers on Glacial Erosions, the Himalayas, and compared it to other mountain ranges. In fact he played a leading role in raising European geological attention towards the Himalayan Mountain ranges.[2]

William Hunter who made an important contribution to Indian botany, astromomy and meteorology also joined the Company's service as a surgeon. He began his scientific career very early in Europe, with his inventions of mechanical contrivances. The improvement of the screw invented by him was dignified in the 'Philosophical Transactions' in 1780. From such a background in mechanics he came to India as a surgeon in 1781 and by 1808 he was at the general hospital of Bengal. This interesting experience enabled him to contribute in several fields like Indian botany, astronomy and meteorology. Hunter continued his contacts with societies in Europe. He was a foreign member of the Medical Society of London and an honorary member of the Academic Society of Sciences in Paris.[3]

Frederick Corbyn, who was a unique organizer, and editor, was one of the major early scientists in colonial India. Born in Manchester in 1792, he passed his medical degrees from London, and in 1813 was appointed to the Medical service of the Company in their Bengal establishment. In 1814, he joined the troops assembled in the

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2 Charles Murchison ed.,*Palaontological Memoirs and Notes of the Late Hugh Falconer, A.M. MD. Vice President of the Royal Society: Foreign Secretary of the Geological Society of London; and for many years superintendent of the H.E.I. Company's Botanical Gardens at Saharanpur and Calcutta, with a Biographical Sketch of the Author*, London, 1868, Robert Hardwicke, Vol. I, pp. xxiii - xxx.

3 Sir Leslie Stepher and Sir Sydney Lee ed., *Dictionary of National Biography, From the Earliest Times to 1900*, OUP, 1917, Vol. X, p. 305.

Tarai 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 to India as the 'Tarai Fever'. In 1818 Corbyn published a small tract describing the disease, its effects, and the manner in which he had successfully counteracted these effects.

Over the years Corbyn was posted in different parts of India - Kanpur, Allahabad, Nagpore. Continuous mobility on service and unaccastomed climate took a toll on his health and he was finally appointed by Lord W. Bentinck as Garrison Surgeon of Fort William. He was also attached with the Orphan Instutition, (Calcutta), succeeding Dr. Brett in charge of the Central Hospital. He was also one of the governors of the Free School of Calcutta and took part in debates about dissemination of knowledge.

From 1818, Corbyn had written continously. In 1819, he gave a short treatise on Cholera, which was followed up the next year by some additional observations on the same disease. His days in Tarai region enabled him to study its topography and he was considered one of the first to discover the tea-plant. In 1828, Dr. Corbyn wrote on the Desease of Infants in India and in 1830 his larger work on Cholera was published. Four years later he became the editor of the *India Journal of Medical and Physical Science*, where he had written his first article. In 1836, he started a new periodical *India Review and Journal of Foreign Science and the Arts*, which he continued to edit, together with the medical journal, upto 1842.[4]

Francis Balfour, who made very important contributions on meteorology's connection with health, was an Anglo-Indian Medical Officer who probably got his M.D. from Edinburgh. He entered the East India Company's service in Bengal as assistant surgeon on July 1769 and was appointed full surgeon on 1 August 1777, and retired from service on the 16 September 1807. Balfour not only interested himself in politics and medicine but devoted much time to oriental studies. He also contributed an article to the *Asiatic Researches* on the introduction of Arabic into Persian and Indian languages.[5]

Sir William Brook O'Shaughnessy, famous for his contribution to Indian telegraph system, also started his career as a surgeon. He was appointed the assistant surgeon in Bengal on 8 August 1833. While in Bengal he wrote numerous articles on medical, chemical, and other subjects but devoted his attention highly to electric telegraph. Anxious to introduce it in India, he published a pamphlet giving the results of experiments done by him, in 1839. He was subsequently appointed Director-general of telegraphs in India, and was sent to England to collect men and material. He returned to India and commenced the work in November 1853. The line between Calcutta and Agra was in working by March 1855. His efforts were recognised in

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[4] *India Review and Journal of Foreign Science and Arts*, (Henceforth *I.R.*), Vol. VIII, no. 4, 1843, pp. 201-10.

[5] Stepher & Lee, *op.cit.*, Vol.I, p. 970.

England. He was knighted for his services in 1856, and elected a fellow of Royal Society on 16 March, 1843.[6]

A very interesting career was that of John Forbes Royle (1799-1858) the only son of Captain William Henry Royle in the service of the East India Company. Born in Kanpur in 1799, he lost his father while he was a child. John was educated at the Edinburgh high school, and planned to joined the army. While waiting at the East India Company's military academy at Addiscombe for an appointment, he became a pupil of Dr. Anthony Todd Thomson, under whom he acquired so strong a taste for natural history and especially botany, that he declined a military appointment. Having obtained his diploma, he became assistant surgeon in the service of the medical staff of the Bengal army and was stationed first at Dum Dum but subsequently to various parts of the garden at Saharanpore.

In 1831, John Forbes Royle returned to England with his collections. The results of his researches he published in his *Illustrations of the Botany and Other Branches of the Natural History of the Himalayan Mountains.* Here he recommended the introduction of Cinchona plant into India, and his suggestions were approved by the governor-general of India in 1852. He was elected a fellow of the Royal Society in 1833, and of the Linnean Society and served on their councils. He was also elected a fellow and acted as secretary of the Geological and Royal Horticultural Societies. He was one of the founders of the Philosophical Club in 1847.[7]

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[6] *Ibid.*, Vol.XIV, p. 1204.

[7] *Ibid.*, Vol.XV, p. 375.

But obviously all scientists in the colonies did not start their careers in medicine and also were not so famous. Some were little known. T.D. Pearse, born in 1738, after servicing as Lieutenant in the Royal Military Academy at Woolwich was transferred to the East India Company's services in February 1768. In 1781, on the formation of the Bengal Sepoy Corps. Warren Hastings resolved to send a detatchment of five regiments for the relief of the Presidency of Fort St. George (Madras), under the command of T.D. Pearse. During the ardous warfare in which they were engaged from that period down to the end of hostilities in June 1783, the Bengal Corps under Pearse established a lasting reputation.[8]

Pearse was a pioneer in the field of Indian meteorology and did one of the first two metearological observations between 1785 to 1788. He also took a lot of interest in astronomy and wrote an article on the astronomical observation between Calcutta and Madras.[9]

Sir Thomas Cautley, (1807-71) who alongwith Falconer was responsible for the Siwalik fossil discoveries, joined Bengal artillery in 1819. It is during his postings in the Himalayas that he developed a special interest in geology and sent about 214 chests of his findings to the British Museum.[10] Thomas John Newbold (1807-1850) who did

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8 *Ibid.*, Vol.I, p. 605.

9 *A.R.*, Vol. I, 1788, pp. 57-121.

10 Stepher and Lee, *op. cit.*, Vol.III, p. 1242.

the extensive geological surveys in South India was the quatermaster and interpretor to the regiment he belonged.[11]

Col. Lambton was a pioneer in the field of topographical and trigonometrical surveys in India. His place of birth is not known, but he resided in Darlington where he got his initiation into mathematical studies from the famous Dr. Emerson. He was procured as a barrack master in the province of New Brunswich in North America. During his sequestration of thirteen years in that country he applied himself to the study of mathematics and topography. In 1779 he joined the 33rd Regiment at Calcutta and was in the army that sieged Tipu's capital.

After the successful termination of the war with Tipu Brigade-Major Lambton put forward to the government plans of a geographical survey of that part of peninsular India. This work subsequently become the nucleus of the Great Trigonometrical surveys of India.[12]

Edward Blyth (1810-73), the curator of the Asiatic Society Museum had a deep interest in natural history from his childhood. He was engaged in reading, making notes, sketching bones, stuffing birds, collecting butterflies. He contributed to the '*Magazine of Natural History* from 1833. His love for science became evident when

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11 *Ibid.*, Vol.XIV, pp. 314-315.

12 *Gleanings in Science*, (Henceforth *Gleanings)*, Vol. 2, No. 15, March 1830, pp. 73-82.

he accepted the small stipend offered by the director of the East India Company for a curator of the Asiatic Society Museum. He arrived at Calcutta in September 1842. In 1849, he published a catalogue of birds in the Society's museum. His stipend never increased and he suffered from ill health. In 1862 his health compelled him to return to England. At home, Blyth's abilities and knowledge were highly appreciated notably by Charles Darwin who repeatedly referred to his observations in his '*Animals and Plants under Domestification*. Many papers by him were published in the *Annals of Natural History, Zoological Proceedings, Zoologist* and *Ibis*.[13]

Finally I would discuss two very interesting characters. Although working in very different fields both had similarities in the vastness and diversity of their experiences and knowledge and also in the nature of their fascinating discoveries. Both of them could make very little name in Europe, inspite of their achievements.

Dr. R. Tytler's discoveries in electromagnetism in India probably remained unknown to the scientists in Europe. He was born at Brechin, Augurshire, Scotland. He commenced his medical career in H.M. service and was appointed assistant surgeon to the 81st foot. In 1807, he entered the Companys' medical service in the Bengal establishments. He subsequently proceeded to Java, and was appointed to the charge of 5th Volunteer battalion. While there, he made some valuable study of the mythology of that country. Dr. Tytler's attention was likewise attracted to the destructive and

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13 Stepher and Lee, *op.cit.*, Vol.II, pp. 738-39.

malignant character of the fever so prevalent in Batavia. He argued that the origin of that particular fever did not exist in the climate of that island, but was to be ascribed to the particular obstruction to general ventilation which were discovered in every dwelling of Batavia. Under the signature of 'Benevolous', therefore, Dr. Tytler published in the Java Gazzette, in 1815, some useful hints on the causes of the unhealthiness of Batavia. In March 1817, he was directed to take charge of the medical duties of Zillah Jessore. While at this station he printed a concise narrative of facts connected with the cholera which occured in the district of Jessore during the months of August and September 1817, and made some observation upon 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 but prior to the latter. He also studied the influence of magnetic geological geometry upon the science of geology. At the same time he was an expert in oriental languages and literature. He presented to the Asiatic Society Museum a brass statue of Buddha from Arracan, Burmese manuscripts and a considerable number of ancient and pure classical works. He was also considered an expert in Hebrew.[14]

However the most colourful personality was Henry Piddington, who apart from being a meteorologist, was the foreign secretary to the Agricultural Society of India, sub- Secretary to the Asiatic Society, founder and curator of the Museum of Economic

[14] *IR* Vol. III, April 15, 1838, pp. 40-46.

Geology, President of the Marine Court of Enquiry and Coroner of Calcutta. He was bred in 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 sugjects to the *Transaction 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 important cyclones that occurred in the East. This required a vast amount of patience and industry. He was the one to coin the term 'cyclone' to describe oceanic storms in this part of the globe.[15]

These men from different background and experiences needed a common platform, a place to assemble in a foreign country, to discuss their work, gather instructions, discuss current discoveries in Europe and also publish their own works. Sir William Jones created such an institution in 1784; in Calcutta - The Asiatic Society. It was this society and its journals which played an important role in promoting and encouraging scientific researches in this country. This society was the first of the many other clubs and societies to come up in India in the years to follow. The Bombay Literary Society (1804) later became the Bombay Branch of the Royal Asiatic Society with aims and objectives similar to that in Calcutta. In the same pattern the Madras

15 See Chapter III, p. 113.

Literary Society, an auxilliary of the Royal Asiatic Society was founded in 1818. The Asiatic Society (Calcutta) even set a precedent for the metropolis where the Royal Asiatic Society came into being much later (1837). For many years to come, the society in Calcutta remained the only science society in India to hold regular meetings on scientific themes, and publish journals relating to all branches of useful sciences of the West. In my next section I would like to show the role played by the Asiatic Society in scientific researches and in the constitution of colonial knowledge, power and 'orientalism'.

Orientalism and Science: A Historian's Predicament

History writing on colonial India has never been the same ever since Edward Said's classic *Orientalism* was published.[16] The book had not only questioned the various assumption regarding politics and society of the 'orient' but had also opened up the scope for various fields of study 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 oriental was forced to live. In defining occident's

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16 Edward Said, *Orientalism*, Routledge and Kegan Paul, London and Henely, 1978.

distinctions from the orient the Europeans 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.

Works on India have largely centered around the various orientalist texts produced under the Asiatic Society from the late 18th century.[17] The various members of this institution, particularly William Jones studied various aspects of Indian society, law, religion, rituals, which they argue led to the formation of an orientalist knowledge about India's past and present. The recent works have debated on the nature and extent to which this link between orientalist knowledge and power operated in colonial India.

However, the potroyal and assumption of the Asiatic Society, as purely 'orientalist', certainly limits our understanding of the wider perspectives of this institution and its member. Critics of orientalism, for example, ignore the various researches in natural sciences like meteorology, botany, geology which were carried out by this institution in different parts of the country. Can these researches be depicted as 'orientalist'?

This question is pertinent because it was under the institution of Asiatic Society, from the same period (1780s) that researches of orientalist and scientific varieties were

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17 See the various articles in Carol A. Breckenridge and Peter Van der Veer edited, *Orientalism and the Post Colonial Predicament: Perspectives on South Asia*, University of Pennsylvania Press, Philadelphia, 1993.

carried out. The question is important because scientific discourse was also concerned with issues of knowledge and 'power'. Such a link would certainly widen the conception of orientalist discourse as hitherto understood.

But what I would like to argue here is that science, particularly natural science, functioned at a level distinct from that of Orientalist discourse. I would also like to suggest that the preoccupation with the Orientalism often denies the possibilities of other frameworks of knowledge in colonial India.

I have already stated how the philosophical developments of Europe led to a rise of an 'objective' outlook towards nature. Science gradually imposed on nature a wholly rational, intelligible design. In this rational objectivity the ingredients of the "imperial"view of nature lay. It led to the idea that nature around the earth could be described by singular laws and thus could be understood in a manner more complete than that hitherto known to mankind. This "understanding" sanctioned "control" - the domination of the earth and nature by mankind. Often promoted in the name of a purely secular welfare it became one of modern man's most important ends. A new world was visualised in which science would give mankind absolute power over land and its creatures. Along with these aspects of dominance and control this imperialist scientific knowledge also delegitimised all other tradition of knowledge of nature both in Europe and elsewhere and established itself as the only true, rational and legitimate epistemology.

This was certainly different from the Orientalist vision. Here the very spacial connotation was different. According to Said, orientalism assumed the world is made of two 'unequal' halves, orient and occident, where the first was not only different from but also inferior to the latter. The effort was to understand, control, manipulate and even incorporate what is a manifestly different world. This resulted in an uneven exchange with various kinds of power.

Western science, at least natural science, was not concerned fundamentlly with these two divisions of the world. In modern scientific discourse, the whole world was divided into the metropolis and periphery. Metropolis was London, Paris and few other centres of modern scientific researches and periphery was the rest of the world where such ideas and theories were experimented, including different parts of Europe as well as America, Asia, Australia and Africa. For it power and control were to be established over nature and the natural world by mankind.

Infact, even in the Asiatic Society two separate fields of study were clearly identified. At its foundation, Sir William Jones said in the inaugural speech -

> 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 condition of life, such inquiries and improvements, could only be made by the united efforts of many.

> If now it be asked, what are the intended objects of our inquiries within those spacious limits, we answer, MAN and NATURE, whenever is performed by the one, or produced by the other.
>
> Agreeably to this, you will investigate whatever is rare in the stupendous fabric of nature, will correct the geography of 'Asia' by the new observations and discoveries...[18]

Thus the society started with studying both 'Man' and 'Nature'. It had the dual role: one of studying the culture, language and tradition of India which was the focus of orientalist interest; two, a study of the physical world of this land. Both were maintained as separate disciplines and were studied separately. The Society published its first journal *Asiatic Researches* in 1788 with these twin objectives. The journal carried various scientific papers along with studies of Indian rituals, astronomy, and practices. Soon enough it was being felt that a special body for specifically scientific researches was needed within the society. In 1808, 7 September it was resolved:

> 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.[19]

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18 *Asiatic Researches, Comprising History and Antiquities, The Art, Sciences and Literature of Asia* (Henceforth *A.R.*) Vol. I, 1788, Speech by President, Asiatic Society of Bengal, "A Discourse on the Institution of a Society. For inquiring into the History, Civil and Natural, and Antiquities, Arts, Sciences and Literature of Asia".

19 *A.R.*, Vol. XVIII, 1832, pp. i-ii.

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, who felt an interest in scientific enquiries and who conceived that the ordinary meetings of the society were held at intervals too remote and purposes too miscellaneous a nature to be calculated to promote scientific investigations, were induced to consider the most effective means to be pursued for the special furtherance of that interest. Thus on the 2nd of January, 1828, it was resolved at a General Meeting, that a physical committee should be formed. Resolutions were at the same time passed, 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*.[20] This is an important development for two reasons. It shows how scientists tried to separate themselves from the 'too general' orientalist interest of the Asiatic Society. It also shows an important stage towards the professionalisation of scientific activity in colonial India.

Upon the organisation of the physical committee, communications were invited from various parts of India. Apart from a more concentrated attention to science, the committee had another major aim of providing a platform for all those men who were scattered in different parts of the country and worked independently. This was largely an extension of the aims of Asiatic Society. As the editor of the *Asiatic Researches* wrote, the committee was formed with the-

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[20] *Ibid*.

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 persuits, than 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 precisions, facts, that this class has been established. Scattered as are over 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 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 those 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.[21]

The passage reflects precisely the way the committee, and for that matter the Asiatic Society, intended to patronize and emcourage scientific researches in this country which was so vast and so little explored. The response that this committee received was overwhelming. Hardly a year had elapsed before materials were ready to fill 266 pages of a quarter volume, and furnish twenty maps, plates and charts. These formed the first part of the eighteenth volume of the *Researches*, published in 1829.[22] Thus the society provided guidelines and set the agenda of researches. It is by this role it drew the strict boundaries of 'rational' research. It decided on the question to be askeed, on the methodologies to be followed, and in effect made an attempt in reducing arbitrariness of individual endeavour. It is in this capacity that the

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21 *Ibid.*, pp. ii-iii.

22 *Ibid.*

society gave a certain shape and direction to scientific researches in India. The society thus functioned within the contemporary rationalist, emperical paradigms of European Science.

However, it is in this positivist empericist project that the two interests, the orientalist and the rationalist scientific had common grounds. The emphasis for both on factual study - one concerned with 'ordering' of India's natural world and the other with ordering its tradition languages and cultures. But even on the questions of empericism the motivations for both were rather different. David Ludden who attempts to link up the two on the grounds that they shared a common empericism ends up without much success.[23] Ludden's essay actually demonstrates how difficult it is for historians to think about India in solely orientalist terms.

To begin with, Ludden's article suffers from a very narrow source base. It only bases itself on some recent collection's of old texts and letters. The second and the more crucial problem, which partly results from the first, is his approach to 'empericism' in a colonial situation. He talks of 'oriental empericism' but fails to give a proper definition to it, one that can be distinguished from other empericisms. He has argued how the empericism of the various 'orientalist' writers led to 'factualized' statements on India. This empericism led to routinized and systematic knowledge production that largely constituted 'orientalist' knowledge. He talks of Jones'

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[23] David Ludden, "Orientalist Empericism: Transformation of Colonial Knowldege", in Breckenridge et al. edited, *op.cit.*

empericism and contribution to colonial knowledge through his studies of Hindu and Mohammadan laws, and argues how these were influenced by the imperatives of political centralization and colonialism. Ludden, however, fails to mention Jones' empericism in his botanical researches on Linnoeus' model. Would that empericism fit so nicely into this question of colonialism ?

Ludden infact mentions scientific surveys - Rennell's maps of India to show how scientific researches were focused towards the acquisition of colonial knowledge. But can the same be said about all forms of scientific empericist researches in India ? Can colonialism be linked so directly with scientific researches ? Can one talk of 'empericism' in the Indian context without any mention of those detailed botanical, paleontological, zoological researches done by those scientists ? Were all forms of empericism similar ?

A major weakness of Ludden's work is that he links up knowledge and politics very closely. He writes, "Foundations of orientalism lie in the transition to Company rule in India, since 1770-1820, when producing new knowledge about India was bound *tightly with political patronage*" (emphasis mine).[24] Such an understanding of knowledge production and colonialism is far too simplistic. On the question of patronage in scientific knowledge, this dissertation will show how individual initiative and a variety of institutional guidances played a more dominant role. In this regard my

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[24] *Ibid.*, p.253.

arguments come close to that of Rosen Rocher. She argues that knowledge and government objectives were not always related and their relationship was not unidirectional.[25] The publication and distribution in Britain of the English translation of the 'Code of Gentoo Laws" was not intended as a tool of law enforcement but as an advertisement of Indian culture.

Rocher makes a further point, although she does not pursue it through. She suggests that projects which did not stem from administrative concerns were, however, later used for political and administrative purposes. Developing this argument I would say that this distinction between motive and outcome is often ignored and projects are judged by the nature of their final application rather than their initial conception. This is particularly common for science, where its association with colonialism in the later periods overshadows the initial objectives behind such researches in India.

The scientific knowledge of Indian conditions, certainly provided the government with the necessary premises of rule. It is also true that gradually with the orientalist redefinition of the east and the assertion of cultural superiority of the west, western rationality certainly became a dominant paradigm of knowledge, but that was not why scientific researches were started in India under the Asiatic Society. The scientist were involved with questions of knowledge which were not of immediate interest to the colonial state. This is where my argument becomes similar to that of Rocher but also

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[25] Rosane Rocher, "British Orientalism in the Eighteenth Century: The Dialectics of Knowledge and Government", in Breckenridge et al. ed.

very different in content from her's. Individual initiatives in her thesis, divorced from government aims, were nevertheless attempts to understand the unfamiliar society of India, to define it for themselves. The individual initiatives in my work were aimed towards understanding of India's natural world in terms of the prevalent scientific theories of nature throughout the earth.

Now let us go back to the Asiatic Society and its functioning. The subjects to which the attention of the Physical Committee was principally directed were Zoology, Meteorology, Minerology and Geology of India. A survey of the different researches done under this committee also reflects the similar urge to encourage varied projects at distant places. Reverend R. Everest ventured into the field of fossil geology, an unfamiliar field for him, only to "induce others to join in a pursuit".[26] 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, the object of which is, to render available to the students of Indian plants information scattered over a thousand detatched works, and therefore only accessible to the professional botanist.[27]

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26 *A.R.* Vol. XIX, 1839, p. 107.

27 *The Journal of Asiatic Society of Bengal*, (Henceforth *JASB*), Vol. XV, 1856, Part I, p. 405.

The society in its own small way provided encouragements and respects to contributors of scientific knowledge. It gave a public recognition to Dr. Spilsbury for his services. A subscription was entered upon among the members for a potrait of Spilsbury to be hung up in the society office.

But at the same time sharp criticisms were also made at what were considered errors in scientific pursuits. In the posthumous biographical note of Dr. Tytler, a very important contribution in electro-magnetism in *India Review*, made an interesting comment about the religious overtones in his pursuits. After discussing in detail his many achievements, it commented-

> he (Dr. Tytler) displayed a want of judgement in the excercise of his great abilities. He blended his religious opinions with scientific speculations, and would demonstrate, by mathematical problem and electro- galvanic magnetism, the spirit of God.[28]

The secularisation of scientific knowledge, the separation of the natural and the super natural, and the interpretation of science as theologically value free, was being established by the 19th century. This criticism of Tytler's arguments by the editor illustrates how spirituality was considered an anathema in the discipline of science. What I would like to particularly point out is the fact that criticism and self-criticism was part of the discourse of the community of scientists in the colony.

It was with similar intention of encouraging scientific researches in various fields and providing information on such projects that various journals came out under the

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[28] *I.R.*, Vol. III, April 15, 1838, p. 46.

auspices of the Asiatic Society. The *Gleanings in Science* was published for sometime from 1829. Its aims were, as the name suggests, to encourage researches on science;

> 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 and 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 indolence which are the bane of our Indian clime, might be in some measure counteracted.[29]

Apart from the *Gleaninings, Researches* and *Journal of the Asiatic Society of Bengal*, there were many other journals published by enthusiastic individual members of the 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 journals had their specific fields of interest and research.

Corbyn's journal was started with two aims. First, to publish various researches being done in Europe which would help the scientific comunity of India to be informed of the latest scientific developments. Second, to awaken and promote a research interest among the Europeans in this country which would result in the prosperity of

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29 *Gleanings*, Vol. I, 1829, pp. 6-7.

India.[30] What appealed to Corbyn was the possibility that India might develop like Europe through Western Science.

> .... We considered ourselves justified in stepping forward, humble as our pretentions 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 discemination 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....[31]

Thus the Asiatic Society and its Journals were committed to the expansion of Western Science and knowledge. Science could also be useful for development and prosperity. These were similar to the perspective with which science was pursued in Europe.

The Asiatic Society gave these men a scope of expressing themselves, of engaging in activities which were hitherto only to be found in Europe. Naturally the society meant a lot for them. It meant a place where they could get some respect for their work and nurture dreams which otherwise seemed impossible outside Europe. Their dreams around this society, what they wanted it to become is evident from an appeal in 1838 to the governments for funds -

> The Asiatic Society, or it may be allowable to say the metropolis of British India, has had the germs of a national musuem as it were planted in its bosom. As in *Paris* a new era was opened in

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30 *I.R.*, Vol. I, 1836, pp. 3-4.

31 *Ibid.*

> the history of its great musuem, the Jardin des Plantes, through the discoveries of extinct and wonderous animal forms exhumed from the rocks on which the town was built, and which required all the adjuncts of comparative anatomy for their investigation even by the master-hand of the great Cuvier; so in *Calcutta* through the munificance of a few individuals and the development 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 wormly seconded by all who have enjoyed the opportunity of contributing; from *China*, from *New South Wales*, from the *Cape*, and from every quarters of the Honourable Company's possessions, specimens of natural history, of minerology, and geology, have flowed in faster than they could be accommodated,... .[32]

In an appeal to the government there was a possibility of bloating the image of the Society. But what is unmistakably present in this passage is a dream, a dream for the society becoming the 'metropolis of British India', of being able to stand in the same line with the famous Jardin des Plantes of Paris, accumulating specimens from all corners of the world (China, Cape, NSW), just as the institutions of Europe were doing.

Many recent studies of the development of natural history museums, expositions, fairs and other sorts of collections emphasize relationships between colonialism, classification, western style of representation and display. Museum collections, whether exhibited or not, are invested with a capacity to represent colonial power. They stand as an objective demonstration of the colonial appropriation of the world. These

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32 *I.R.*, Vol. II, Nov. 15, 1837, pp. 519-520.

collections, which did not capture a culture but were merely objects named and classified by western collectors, became elements in making of a 'superior' consmopolitan western culture.[33]

However, as I have argued earlier, it seems to me very important that we do not mistake the specific meaning finally given to an object or collection, as to be the goals of individual donors or collectors contributing them. The growth of the natural history museum in the early period did not show such elements of colonial cultural representation. The above passage shows the strict scientific aim of collection and a desire to achieve a fame similar to those institutions of Europe. The fact that rocks and fossils from different part of the world, including Germany, England were displayed here makes the connection with colonialism ambiguous. The museum was obviously for display, but they conveyed a different meaning to scientists in the early 19th century. It symbolised their achievement, it was a manifestation of their hopes, dreams, pride, and committment to the discipline.

The committment towards their discipline was affirmation of their faith in a positivist pursuit of knowledge - of knowing the unknown territories, and the puzzles of nature. By the 18th century western science had dramatically changed European philosophy, culture and society. The attitude towards science in the colonies often

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33 Edgar V. Winans, "The Head of the King: Museums and the path to Resistance" in *Comparative Studies in Society and History*, vol. 36, No. 2, April 1994. Also David Jenkins, "Objects,Lessons and Ethnographic Displays: Museum Exhibitions and the making of American Anthropology", *Ibid.*

reflected these social and intellectual transformations of Europe. There was a strong consciousness of a 'new knowledge' based on rationality and evidence. Many of their writings reflected a sense of reverance for this 'new science'. It was seen as a new pholosophy which they believed would bring about new era in human history.

The New Science

Francis Bacon seems to have been one of the most influencial philosophers. Many of his philosophical ideas were quoted or mentioned in various texts. He was one of the most important proponents of the imperialist nation of science. The study of nature was for him a vigorous conquest of nature. Reason was an instrument of this conquest.

Baconian pholosophy of science marked a break from the classical mathematical physics. It lay more emphasis on experiments, it tended to see how nature would behave under previously unobserved, often previously non-existent circumstances. These were the experiments that took nature to the laboratories, constrained and exhibited it under conditions it could never have attained without the forceful intervention of man. This tradition certainly put more stress on instruments - the next hundred years witnessed the rapid introduction of microscopes, telescopes, thermometers, barometers, air pumps etc. In less than a century physical science became instrumental.[34]

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[34] Kuhn, "Mathematical versus Experimental Traditions in the Development of Physical Science" in his *The Essential Tension: Selected Studies in Scientific Tradition and Change*, The University of Chicago Press, Chicago and London, 1977.

The various scientific researches in colonial India involved extensive use of instruments brought from England. On various meteorological, trigonometrical and astronomical surveys and also botanical researches - the Baconian emphasis on instruments and experiments become very evident.

In a long review of Bacon's famous work *Novum Organon Scientarium*, (A New Machine of Sciences) in *India Review*, the reviewer argued that Bacon's methods which appealed to "observation and experiment and consciousness" to arrive at "established universals" were much more authentic than the syllogistic abstractions of Aristotlean Philosophy.[35] The following quote from the review would reveal the particular inclination towards this tradition of scientific empericism.

> His purpose was, from a knowledge of ascertained facts, to ascend to the knowledge of some general harmonizing principle, and thence to a higher generalization, and thence to a higher still, in onward enlarging progression. *Such is the true and legitimate method of induction...* (emphasis mine)[36]

Along with this was the disregard towards traditional forms of knowledge. There was this very interesting letter in the *Review* where the writer expressed his disregard for of older forms of science like Alchemy and Astrology. He expressed his surprise that an experiment of 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

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35 *I.R.*, Vol. VIII, no. 8, August 1843, pp. 486-501.

36 *Ibid.*, pp.490-91.

merchants patronized a native alchemist to produce gold from dew-drops. The letter wondered how subjects like alchemy and astrology still attracted despite, "the advance to which learning has attained in the present year of grace, 1843."[37] These disciplines were summarily discarded as non-sciences and irrational.

But the most interesting piece of work in this regard seems to have been a small booklet called *Conversation about Hurricanes* by Henry Piddington.[38] By the 19th century there was another development in Europe in which the mathematatization of a number of Baconian fields took place. Mechanics and hydrodynamics was first mathematized. Gradually the work of Laplace, Fourier, Poisson made mathematics

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37 The letter ran somewhat like this -
To the Editor of *India Review*,

Dear Sir,

... *Astrology*, however, despite its incontrovertible regulation furnished by its own inconsistencies, if the successful publication of such books as Raphael's Manual' and other works of the like character justify an interference, (sic.) is still a branch of science (!) studied and partronized even in enlightened England.

... These are follies, however, which the scientific Journals of Europe have done - and are doing much to eradicate in that quarter of the world. May your Journal, Dear Sir, as far as its influence has extend, do so much in the service of the true philosophy in the east ... .

Yours faithfully,

...

- *I.R.*, Vol. VIII, Part no. IV, April, 1843, p. 235.

38 Henry Piddington, *Conversation about Hurricanes; for the use of Plain Sailors*, Smith Elden, London, 1852.

essential to the study of heat magnetism and optics. This resulted in a lowering of the barriers between the two traditions. Piddington's study of cyclones, involved all these sciences - a study of heat, hydrodynamics, optics, magnetism. This book apart from reflecting the general consciousness of the 'new science' also demonstrates a fusion of these two traditions. The book was written in the form of an imaginary conversation between a naval scientist (Mr. Helmsley), his nephew who were acquainted with the 'new' naval science and two old sailors who had been in this profession without being formally trained in it.[39] The book is an unfolding of a drama in which the non-believers are pursuaded to see the advantages of the new science. As Piddington himself was one of the pioneers of this science (See Chapt. III) it is interesting to read how Mr. Helmsely who articulates the authorial voice argues about the advantages of this new science and the problems of the earlier. Piddington first shows how the saliors reacted to this new science, "the new fangled science". In his career as an observer of storm (as he says in the introduction) pattern he must have come across such reactions.[40] Capt. Wrongham, one of the sailors says,

> ...Here is my mate, Saverns, who has sailed with me since he was a boy, and is fit to command any ship out of the port of London to any part of the world, ... and yet he gets turned back for a few days, "to study the law of storms" as they call it !
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> ... for it is a disgrace to be told you donot know any thing in your profession; ... And I can't see what right they have to call upon us old sailors to know any new 'science', as they pleased

39 *Ibid.*, pp.5-6.

40 *Ibid.*

to call it, especially if one do not believe a word of it, like me....[41]

What is to be noted here is the interesting tussle between the sailor and Helmsely; between knowledge best on experience and the knowledge of modern laboratory research. The critique of experimential knowledge by laboratory based calculations has been one of the most important changes that modern science has brought about. Historians have criticised this disregard of human experience and the dehumanization of the knowledge about nature.[42] Alexander Koyre the great French historian of science has shown this particular break brought about by modern science.[43] Here a similar kind of conceptual conflict was been re-enacted in the colony.

The booklet proceeds to demonstrate how the new science has the 'right' to be accepted as the only form of knowledge. Helmsley adds, "I must affirm that it is you who have *no right* to deny what is plainly grounded on pure, though very simple, *mathematical demonstration*".[44]

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[41] *Ibid.*, p. 5.

[42] In this critique Paul Feyeraband's *Against Method*, *op.cit.*, is the most outstanding work. In the specific case of India, I would suggest the readings of Ashis Nandy, Claude Alvares, Shiv Viswanathan which I have cited in the introduction.

[43] Alexander Koyre, 'Galileo and the Scientific Revolution of the seventeenth century', and 'Galileo and Plato', in Redondi et al. ed.

[44] Piddington, *op.cit.*, p.4.

Piddington sought to establish this 'right' by showing the methodical and mathematical procedures, by arguing that the old system was hardly based on 'reason': it had no understanding of 'why' the wind blows in a certain pattern. The final triumph of modern science over the old is asserted by the end of the book. The two sailors, initially such strong critics of the new science come to accept its wisdom Capt. Wrongham finally exclaims 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 cleverest of us was often mistaken; but I think now that with a good look out on the signs of the weather one can scarcely be caught uprepared.[45]

'*Conversations* not only shows Piddington's faith and attitude to the new science but also reflects how that science was sought to be propagated, how faith had to be inculcated in unbelievers. These books were obviously written in very simplistic styles. The question -answer pattern in *Conversations* according to Piddington was particularly for that, to be easily understood. The Asiatic Society's efforts were only limited to the learned, scientific community within the country. Piddington's booklet attempted something different. In this attempt to make the new, unfamiliar science easily understood, and in this attempt to study natural phenomena away from the natural surroundings, with the help of instruments and charts, the Baconian influence was

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45 *Ibid.*, p.93.

apparent. The book infact starts with a very significant quotation from Bacon's *Advancement of Learning*. It shows the importance of demonstration through experiments and the need to prove theories of nature:

> those whose concerns are beyond popular opinions have a double labour; the one to make themselves conceived and the other to prove and demonstrate.[46]

It is this combination of two different traditions of mathematics and experiments, both in their own way objectifying and factualising in nature, that marked a clear break from traditional theories of nature.

It is with such faith and conviction in the power of modern science that the scientists engaged themselves in different pursuits. This meant hardship and sacrifice, particularly in a colonial situation where little encouragement was forthcoming. Yet they carried on because this is what they believed in doing and considered as noble. As William Jones wrote in 1790.

> 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 love knowledge as we love light, even when we have no design of applying either to a purpose essentially useful...[47]

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46 *Ibid.*

47 *A.R.*, Vol. II, 1790, p. 315.

This vision of science and knowledge was shared by metropolitan and colonial scientists. Scientists from both the fields were working with similar methodology, faith and committment. 'Colonial science' was actually a western science: the colonial context certainly brought about new dimensions to it, but the basic context in the 19th century was the same positivist one, anywhere in the world. It is this larger committment to a conception of the world that this thesis would like to elucidate. In contemporary Britain, the Royal society had very similar schemes. In 1820, Sir Henry Davy, on taking the chair at the "Ordinary Meeting of the Royal Society", lectured on the Present State of Royal Society and the Progress and Prospect of Science -

> Gentlemen, to conclude, I trust in all our researches we 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 our intellectual visions, 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,....[48]

Nineteenth century Europe was obsessed with the positivist pursuit of knowledge: to know more about the world around us, to trod into untrodden territories. While the break in western science had come as early as the 17th century, what was new to the

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

enterprise was an effort towards gathering scientific knowledge along with knowledge of society and culture about the distant parts of this earth. In natural science, thus we see striking similarities in the aims and plans of researches both in England and in India, they belonged to the same project. Science, as defined in one issue of *Asiatic Researches* was "To acquire an accurate knowledge of facts to a synthetic explanation of particular phenomena, ..."[49] It is precisely from such an understanding of science that extensive surveys and researches were carried out throughout the regions 'yet unexplored' by western science.

The extensive Trigonometrical surveys under General Lambton were a case in point. Lambton's objective was to ascertain the great geographical features of a country upon correct mathematical principles: the maps of every district could then be combined into one general map. First the latitudes and longitudes of important places were determined.[50] Then a meridional series was charted down the middle of the Peninsula, terminating at the sea near Cape Comorin, from which were extended other series to the east and west, along both the coasts.[51] This project was, as Lambton writes, an extension of similar surveys by Europeans elsewhere. The survey in England under Colonel Mudge was to obtain a correct plan of the island of Great Britain, to locate the geographical position of all known places, in latitude and longlitude. The

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

[50] *A.R.*, Vol. VII, 1808, p. 312.

[51] *A.R.*, Vol. XII, 1818, pp. 2-3.

members of the Swedish Academy were likewise doing similar work. All these researches including those in India would provide, as Lambton conceived, "the most extensive and most accurate data hitherto obtained for determining a question of great importance in physical astronomy, viz the dimensions and figure of the earth".[52] Western Science had started to break away from its European geographical boundaries and started to venture into unknown parts of the world in search of comprehensibility, guided by its theories on the physical world. This shows that arguments of Ludden about mapping and imperial question are rather simplistic. The trignometrical surveys were conceived for scientific reasons - to determine meridional arc and to settle various astronomical questions. Infact the scientists themselves said, as I have shown later, that these maps had no economic or administrative promise for the government.

In natural history also we see a similar interest and emphasis on extensive surveys throughout the country. John McClelland was particularly engaged in this field. From time to time he provided guidelines and instructions and encouraged more extensive natural history surveys. In a small essay entitled "On the Importance of Minute Inquiry on Natural History", he made the aims of such a study in India clear. After showing the important role natural history played in Europe in medicine, and geological knowledge he comments:

> ...If Natural history has so much to recommend it in Europe, how much greater are the attractions it holds out to those who are

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52 *Ibid.*, p.3.

> 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 had never been created".[53]

But at the same time McClelland was careful to note the dangers and difficulties of such researches in India. He gave very clear instruction in his letter to the Editor of *India Review* -

> ... I propose to myself the invidious and perhaps thankless task, of urging the necessity of confining our contribution as much as possible to the narrow limits of original and well observed facts. without a degree of self denial that should induce us to withhold the results of unwearied enquiry until we are satisfied of their accuracy no vigilence on the part of others now connected with the management of the society can suffice to guard against the introduction of error into the proceedings, and surely such caution is not too much to expect from those who desire that their authority should command the respect in science...
>
> Patience, disinterstedness and self denial, are characteristics of all those who would obtain a distinguished place in science,...[54]

McClelland believed that such sacrifices and hardship in collecting obscure species from the remotest corners of the earth had its own rewards. Not of course financial, since the government, particularly the colonial government stood to gain very little from these studies of minute flore and fauna. It offered, he believed the two most

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[53] *I.R.*, Vol. II, no. 15, 1837, pp. 561-62.

[54] *I.R.*, Vol. III, no. 15, 1838, pp. 544-46.

desired yet ellusive things for a person working so far from Europe - scientific fame and acceptance among the metropolitan scientific community as well as the satisfaction of making a fundamental contribution. He made this clear to his colleagues -

> We should ever recollect that the easiest and best way to promote our fame, and contribute at the same time to the advancement of natural history, is by making collection, nor are we without examples of the highest award having been though somewhat prematurely, conceded to collectors ....[55]

In Botany and also to some extent in Entomology India offered a wide diversity of species. These were not always 'new' but such a wide distribution of flora and fauna had a very important scientific significance. Thomas Thomson studying the 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 occurance 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, of a polynesian flora in Malaya, and of numerous African types in the mountains of the Madras Peninsula....[56]

In Natural History such identification of flora and fauna with those in other parts of the earth has a special significance. Often these findings were extended to

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55 *A.R.*, Vol. XXI, 1839, p. 259.

56 *JASB*, Vol. XV, Part I, 1856, p. 414.

understand pre-historic bio-migrations and also to propose the theory that the entire world was once a common mass. Geological studies in both western and non-western worlds also substantiated such researches. (see chapter 4).

Recognition and Indifference

So it was as a part of a larger scientific agenda that western science came to non-western lands. It is this venture which opened up various parts of the world to western science. This led to another development that challenged established scientific theories of Europe. Experiences from these 'new' corners could thus play an important role in the constitution and transformation of metropolitan scientific knowledge. At least, that is what the researcher thought. This sense of optimism and confidence is of particular interest here. The Trigonometrical surveys in India, originally concieved as an extension of similar European surveys, exposed some of the problems of existing theories. John Warren, investigating the effects of terrestrial refractions in Mysore country, wrote:

> Not withstanding the various theories which have been advanced, at different times, to account for the effects of refraction (Particularly by De Cartes, Leibnitz, the two Bernouillis and lastly Sir Isaac Newton, whose hypotheses, grounded on the laws of attraction now generally obtain among physical writers, and the numerous experiment which have been made by the most eminent philosophers of our times, with a view to discover some law by which its effects might be reduced to certain narrow limits, applicable to practice, nothing sufficiently satisfactory has

yet occurred to set the question finally to rest ...[57]

To existing theories on refraction which he had encountered in the process of his researches, Warren suggested specific 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 generalised, might be attended with incalculable advantages to science.[58]

Similar suggestions or observations were often made for geological sciences, meteorology etc. In entomology, Nienotrer's paper, which I will discuss in some detail later, also shows how tropical India opened up new areas for western science.[59]

Claims about original discoveries were made in a variety of fields. Dr. Tytler claimed that discoveries in Electro-magnetism were made simultaneously to if not before, those of Faraday. In a letter to *Calcutta Courier* he quotes one of his earlier letters (7/5/36) to the same journal. The earlier letters, he claimed, had clearly shown

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57 *A.R.*, Vol. IX, 1811, pp. 1-3.

58 *Op.cit.*, p.3.

59 *JASB*, 1856, Vol. XV, Part I, pp. 381-84.

that he discovered it before Faraday, who did it on 30th January 1837. The second letter went like this, after he had quoted his earlier one -

> 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 letter addressed by me to the Editor of the *Calcutta Courier* on the subject of the *Electro Magnetism*; although from the language of Faraday respecting the *attraction* and *repulsion*, it is apparent that he is as yet, wholly ignorant of the immense affact (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.[60]

Dr. Tytler most probably died within a year and half after making his claims. Unfortunately his interesting propositions were not followed up by any further comments by any other scientist. But what comes out from his letters to *Calcutta Courier* is that he had done detailed researches to back his claims. His papers were all accompanied with detailed diagrams, figures and explanations. Tytler infact is a classic example of a scientists who worked in an obscure station in India (Futtehgur), silently carried on his project without much patronage, wrote to scientific journals from time to time about his discoveries, was confident enough to make a claim with detailed data against someone like Faraday, but died without any recognition from the scientific community of Europe.

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60 *I.R.*, Vol. II, no. 15, 1837, p. 544.

The question of recognition was important. Staying and working in a country like India where the European "enlightened portion of world scarcely fill an English village", Europe appeared as the only place to earn recognition for work. Many of them after finishing their career here went back to England and published their work there. Some of them became Fellows of the Royal Society of London. The equation of power between the colonial scientists and those in the metropolis becomes clear from the fact that colonial scientists attempted to seek recognition from England and followed the theoretical guidelines of those of Europe. The scientists in the colonies often designed their societies and clubs after the pattern of those in Europe. The format of their journals were similar to those in Europe. Frederick Corbyn admitted the influence of journals like *Records of Science, Philosophical Journal*, the *Mechanic's Managine and Repertory of Inventions and Arts* in his *India Review.*[61] Asiatic Society, Calcutta, was influenced in its conception by the Royal Society of London.

There was an attempt to attract the attention of European institutions to their researches as that was the only way they could hope to make their researches known. The report on the progress of Indian Maritime Surveys argued that the charts of captain Ross in India and in particular the survey of the Mergui archipelago and Tenesserin Coast deserved the attention of the Geographical Society in England. It expressed the hope that these researches would be appreciated with due acknowledgement to those doing them. It further added, perhaps to substantiate its claim, that if they had the

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[61] *I.R.*, Vol. I, 1836, p. ii.

same facilities for neat engraving that publishers in England had, their work could have appeared more impressive.[62] The question of recognition was often collective - concerning the whole community and their society. This was perhaps because there was little hope of their individual voices to be heard in England. Their attempt was to present the general advances being made in western scientific pursuits in a non-western country. This perhaps explains why Asiatic Society figured so regularly in all their writings.

It is difficult to make any general statement regarding the response of the metropolis from the sources used in the present research. However, excerpts in the Indian journals show some amount of recognition for the Indian publications.

The researches in Medical Science, seems to have attracted some attention. Infact the *Journal of Medical Science* was highly appreciated. *The British and Foreign Medical Review*, was quite surprised at the level of researches and original papers published in this journal.

> We have, we conform been no less surprised than gratified by the perusal of this journal. We were by no means prepared for so much original matter and so much clever and spirited writings as it contains. It is extremely creditable to the editors, and speaks well for the zeal and intelligence of our medical brethren, as a body, in our Indian empire, to whom this journal must be invaluable. We are much stuck by the novetly and importance of many of the original communication on medical subjects.[63]

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[62] *JASB*, Vol. I, 1832, pp. 333-34.

[63] *I.R.*, Vol. VIII, no. IV, 1842, p. 205.

London Medical Gazzette praised Corbyn's efforts in this journal in quite similar terms. The *Journal of Medical Science*, according to them was

> Filled with good and original papers and judicial selections. We must part with him (Corbyn) for the present, once more taking leave to express our respect for his talents, and our wishes for his continued prosperity.[64]

Corbyn's important work *The Diseases of Infant of the Climate of India* was also appreciated highly.[65] European medical knowledge was not yet fully able to understand the influence of tropical climate on the human body. The fact that health was an important European and colonial concern in the 19th century, and that a large part of British colonies was in the tropics influenced this metropolitan enthusiasm for medical researches in the tropics.

Apart from medicine the response towards other sciences was not too enthusiastic. The importance of meteorology was recognised early, but the significant of geology was accepted only after many years of researches in the colonies. Whatever attention natural history got because it promised to reveal the unknown geography and physical structure of the sub-continent. The *Monthly Magazine* of England appreciated Edward Ryan's efforts in publishing the *Journal of Physical Science* (publication of the physical committee of the Asiatic Society) as a depot for the

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64 *Ibid.*, p. 206.

65 *Ibid.*

different observations made in India. This, it thought, was of great significance to science:

> The advantages that must result from this are incalculable, for extensive as our dominions is in India, the natural history of the country is but imperfectly known.[66]

Recognition however, came generally to those individuals who went to Europe and then could influence the scientific community there by their researches. For many this was not possible. After years of hardship in unfamiliar conditions they went to Europe at an advanced age with failing health and little ambition left. Financially also they often saved little to carry on their researches. There were also many who worked and died in this sub- continent without being able to go back at all.

Recognition from Europe, at least in the early 19th century often remained only a dream. Indifference towards their researches and disregard of the originalities of their papers gave rise to a sense of bitterness among those in India.

John Nienotrer an entomologist, in a very interesting essay expressed such sentiments.[67] His essay offered a sharp critique of those in Europe and argued a case for western science in the colonies. He starts very candidly while describing a new "Ceylon Coleoptera"; "I little doubt that the following description of a new coleoptera

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66 *Gleanings*, Vol. II, no. 17, May 1840, p. 165.

67 *JASB*, Vol. XV, Part I, 1856, p. 381.

will meet with anything but aprobation from the entomological world at home".[68] But with striking confidence and optimism he continues:

> 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 vindicate 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 unsurmountable.[69]

Nienotrer ridicules the probable apprehensions that the Western Scientific community might have about researches in the colonies.

> The objection 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 details of the actual progress 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 entomologist's 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 attention, but they should never go to print with matters on which it is an impossibility for ablest among them to be quite competent...[70]

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68 *Ibid.*

69 *Ibid.*

70 *Ibid.*, p.382.

Nienotrer is here talking of problems faced by scientists in general in a colony. Such disparaging attitude of the metropolitan scientists created a deep sense of resentment among colonial researchers . The latter generally felt that they deserved a better treatment from fellow lovers of science particularly since they carried on their research under difficult circumstances. Nienotrer 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 forming an opinion with so much precisions 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 deligent 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.[71]

The stress on extensive and intensive observations and comparative surveys, he hoped could provide vital knowledge to a scientist otherwise uninformed of the latest developments in Europe. But scientists in the colonies also enjoyed some advantages. Nienotrer argued that those sitting in Europe could never study tropical insects alive in its surroundings. This unique, advantage, according to him, could help overcome

71 *Ibid.*, pp. 383-384.

any infrastructural and financial obstacle faced by those practising western science in the non-western world.

> 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 brethren 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 ... .[72]

Nienotrer ended the essay with a powerful criticism of the scientists in Europe: both for their opposition to publications of research and their desire to treat researchers in the colonies as fact collector. What is expressed in the passage is the strong bitterness against fellow scientists and the 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 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 general measure due to himself, reaped rather by another man ... 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 but that he should be the herald of his discoveries himself ? Could anything be more unkind and ungenerous on the part of his scientific brethern at home than to oppose and discourage him by their disapprobation?...[73]

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72 *Ibid.*, p.385.

73 *Ibid.*, pp.384-385.

So the respect for western scientists, it seems, was mellowed and complicated by relationships of conflict. The need for recognition from the west went along with a desire to assert the legitimacy of scientific research in a colony. That Nienotrer's arguments in favour of science away from Europe were appreciated and accepted could be shown from the comments of the great Sir Charles Lyell. While presenting the Wollaston gold medals to Falconer and Cautley, the great English geologist saluted their efforts amongst adverse conditions in the colonies. Lyell also said that being away from the metropolis did not always prove a hindrance as it helped to develope the unique quality "to see and think for themselves".[74] That, however, is the story for the last chapter.

[74] Murchison, *op.cit.*, p.30.

CHAPTER II

Scientists and the Colonial State.

> 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 in not due.
>
> Frederick Corbyn, 1837[1].

In the earlier chapter we have seen how the scientists formed different societies in colonial India. These bodies provided encouragement, information, instrumentation, sociability-benefits to those who sought to pursue research in a colony like India.

If the scientists looked for such support and encouragement from these associations, what were their attitudes towards the British government in India? Placed in a colonial situation where the commercial interests of the state seemed so overwhelming and obvious, what were the scientists' attitudes towards the state, particularly when many of their projects failed to reflect any commercial prospect? Moe generally, what were their attitudes to the colonial situation they found themselves in?

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1 *I.R.* Vol. II, No. 15, 1837, p. 519.

Science, Leisure and Pursuit of Knowledge

The situation was particularly difficult because these scientists were actually Company servants and were engaged in various official duties and could pursue scientific interests only as and when their job permitted. The company was not very obliging because these researches promised little pecuniary gains. Sir william Jones while setting up the Asiatic Society, realised this problem. He expressed it in his inaugural speech in these terms-

> a mere man of letters, retired from the world and alloting his whole time to philosophical or literary pursuits, is a character unknown among *European* residents in India, where every individual is a man of business in the civil and military state and constantly occupied either in the affairs of government in the administration of justice, in some department of revenue or commerce, or in the liberal profession; very few hours, therefore, in the day or night can be reserved for any study that has no immediate connection with business even for those who are most habituated to mental application[2].

As Disraeli said "the East is a Career". Pursuing research outside the so-called 'career' in commercial sectors, was difficult for these men. The lack of time and leisure from the compelling demands of company services was felt as a major problem by these men. As Jones stated it very clearly a couple of years later:

> The greatest, if not the only, obstacle to the progress of knowledge in these provinces, except in those branches of it which belong immediatly to our several professions is our want

[2] *A.R.* Vol. I, 1788, p. 1.

of leisure for general researches;[3]

He illustrated the situation of these scientists 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 inquiries, really want'time' for the pursuit of them.[4]

The dilemma was very obvious. India with its vast diversity provided the attractive 'space' for research yet their occupations denied them the time to do so. For these scientists it was often a tough job balancing the demands of research and job.

Others saw the problem of leisure differently. For them the question of leisure was attached to that of recognition and appreciation of their work. According to the editorial of the first volume of *Gleanings* it was this lack of appreciation which made the differnce with Europe. Even scientists in England, the editor wrote, had their professions to follow but they could find leisure for researches in science because the incentive of recognition was there. In a colony like India, Europeans often did not find the leisure to do research because the hardships were immense and the rewards very few. Thus very few wanted risk their spare time for such an uncertain endeavour.[5]

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3 *A.R.*, Vol. II, 1789, p. 270.

4 *Ibid.*

5 *Gleanings*, Vol. I, 1829, p. vii.

In a colony like India the scientists often lacked the necessary condition and encouragement for their pursuits. There was no receptive audience which could appreciate scientific studies. The commercial compulsions of the colonial state made it somewhat indifferent to such pursuits. Atleast that is what the scientists often felt. The colonial state's indifference towards scientific researches of the state went along with its obsession for commerce. As one scientist complained:

> 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? [6]

Often the government's overwhelming preoccupation with commerce was actually perceived as a major obstacle to such scientific researches. It tended to channelise scientific researches into commercial directions. As 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 productions of Mysore were required to be known, he was directed to make esculent vegetables, cattle, farms, cotton, pepper, sandle-wood cardamums.... the chief objects 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..[7]

There were other complaint about the goverment's failure to appreciate the

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[6] *IR.*, Vol. I, 1836, p. 155.

[7] *Ibid.*, p. 152.

importance of scietific researeches in India. The appointments of surveyors in this country were more for political imperatives, they felt, than for a true appreciation of the nature of surveys. While talking about the little information available about the physical sturcture of India, Corbyn very 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 sturcture of the country. We look to the labours of a Moorcraft, a Gerard and a Burns as sanctioned more for political purposes than those of science,...[8]

What is interesting in these passages quoted above is a strong commitment towards the progress of science as a rational discipline. It was seen as a discipline to be pursued untainted by commercial or political intersts. The pursuit of science was essentially a pursuit for knowledge, of broadening the mind and of getting a clearer idea of the natural objects around. What makes such a feeling interesting in this present case is that it could be retained even in a colonial country. Scientists in the colony were aspiring to fight the malign imperial presence from influencing their work.

Quite certainly their attitude towards knowledge as a pure, objective search was not peculiar to science and scientists. This was actually a part of the positivist quest for knowledge where knowledge is seen as pure, a search for unadulterated truth and unprejudiced facts. This is linked with positivism, with the empiricist notion of truth.

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[8] *Ibid.*

This conception could be perceived in spheres of knowledge other than science.

This attempt to check outside interference, was probably particularly evident amongst scientists. Science unlike many other forms of positivist quest did not function in a public sphere. Scientific papers were most often meant only for fellow scientists and not for general readership. The increasingly complex and esoteric nature of scientific discourse, as evident from the papers and proceedings of the Asiatic Society, limited its readership. Whether such insulation was deliberate or not is a different question. What I would like to suggest here is that because of the particular nature of the emerging scientific community and the discourse in modern science, the question of purity of knowledge perhaps acquired a different significance.

Pressures and Compromises

With such desire for seclusion, how did the scientists hope to tackle their financial needs for the research. Scientists in general need support. Few, usually very few, research projects were economically profitable to the author. Particulary in a country like India, with little general awareness of such studies, financial support was always a problem. Most journals constantly complained of a lack of funds and subscriptions. The proprietors, editors and contributors were all volunteers, who neither looked to gain by the sale of the work, nor received any pecuniary return for their assistance. Yet the journals found it difficult to meet the expenses of printing and postages. Under such trying conditions it was increasingly difficult for these journals to maintain their commitment towards research. Compromises often became necessary for survival. The publishers of *India Review* realised that a journal based solely on abstract branches of science in a country like India where 'the British sojourners and their descendants are comparatively few', had little chance to survive. It thus made a choice:

> It is principally on this account that we determined to blend with purely scientific matter, articles on the mechanical arts, and such other interesting subjects as regard improvement in manufactures, commerce, agriculture,...[9]

Interestingly, even in a compromise like this, the commitment towards 'pure' science remained strong. Infact the 'interesting subjects' were included to sustain the journal- so that it could hope to publish researches on 'pure' science. As the preface to the first volume continued:

> The grave philosopher and the man of science may not delight in articles of the former description, but, by attending to our explanations, 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,...[10]

One alternative to compromise was closure. While *India Review* made a 'compromise', other journals were not ready to do so. The outcome was that most of them closed down after some period. Apart from the *JASB* none of these journals

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[9] *I.R.*, Vol. I, 1836, p. 155.

[10] *Ibid*

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 in 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 case 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.[11]

The journal provided a detailed description of the various financial problems faced by it. Before providing a list of expenses and subscriptions collected to give a proper idea of the problem, it wrote:

> At what sacrifice this (coming to life) must be accomplished the following statement will enable our readers pretty clearly to comprehend, and will afford them an insight to the difficulties which have for same time past led us to comtemplate the entire abandonement of the design with which we started on our editorial adventure.[12]

This apprehension about a total closure seems to have turned into reality quite soon because after the mid 40s no further reference is found of this journal. The fate of *India*

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[11] *I.R.*, Vo. VIII, no. II, Sept. 1843 p. 1.

[12] *Ibid.*

Review infact is similar to other comtemporary scientific journals.

Financial crisis was also felt by the Asiatic Society and other similar institutions. Throughout the 19th century, the society suffered from lack of funds and the condition of the Botanical Gardens at Calcutta was even worse. One reason for this was that the colonial government forwarded little funds. Edward Blyth who was appointed as the curator of the museum of the Asiatic Society for a very small stipend saw it never increase throughout his service of 20 years.[13] His condition was so pitiable that he was forced to ask for a raise to the Court of Directors of the East India company. He wrote:

> That your Memorialist has now passed an important portion of his life in India, and has obtained a familiar practical knowledge of its zoology in various branches, which materially facilitates the prosecution of further researches, and he is still anxious to bestow the extra time required for such labour and investigation, but finds it impracticable upon present allowances.....[14]

The appeal made no impact on the Court of Directors. Blyth had to go back to England in 1862 due to ill-health. In England he got a lot of attention from the scientific community. Even Darwin was impressed by his work. This to some extent helped to erase the bitterness of the disregard he suffered from the colonial

[13] See Chap. I, p. 28.

[14] *JASB*, Vol. XV, 1856, Part I p. 238.

government.[15] But there were many others who were not so fortunate and died in this country, unknown.

Patronage and Independence

What was the attitude of the scientists towards the colonial government? At the beginning the Asiatic Society intended to maintain close ties with the government. When the Society was formed the members asked Governor General Warren Hastings and the members of the Council at Fort William to be honorary patrons of the society. Warren Hastings was also offered the first Presidentship of the society. Hastings agreed to be a patron but declined the presidential post due to lack of leisure. After this William Jones was nominated as the first president.[16]

However, inspite of this early association, for a very long time the society or the scientists did not depend on any major financial aid from the government. The government also took little or no interest in the proceedings or affairs of the Asiatic Society. As I have already shown scientists infact suffered from a general indifference towards their work. Occasionally the cost of postages were remitted. Due to the Society's difficult financial conditions, even such small help were gratefully

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[15] See Chap. I, p. 28.

[16] *A.R.*, Vol. I, 1788, pp iii-iv.

acknowledged.[17]

However the scientists did not easily succumb to the pressures of the situations. They often showed no appreciation of the commercial question which was of prime interest to the colonial government. Despite financial problems they remained committed to the cause of research. Infact in 1837 when the society for the first time made an official appeal to the government for financial aid, it was only to maintain a professional Curator for its natural history museum.[18] This appeal makes interesting reading. After talking about plans to develop the Society like the Jardin des plantes of Paris, it wrote:

> These then, are the motives that have pursuaded the society of the propreity of an appeal to the Ruling power; not to contribute to the ordinary wants and engagements of the institution, but to convert that institution into a public and national concern, entrusting it with the foundation and superintendence of what has yet to be formed for the instuction of our native fellow subject, as much as for the furtherance of science -a public depository of the products of native in India and the surrounding countries properly arranged, and properly applied.[19]

We do not see here an attempt to attract the government by promising economic benefits from such a project. Their concern was the furtherance of science and its

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[17] *Gleanings*, Vol II, 1830, p. V.

[18] *I.R.*, Vol. II, 1837, no. 15, p.518.

[19] *Ibid.*, pp. 519-520.

popular awareness. Such was the case with many other projects and appeals- particularly Lambton's Trignometrical Surveys.[20]

There was a fear of government interference and an attempt to keep a distance between the government and the academic institutions. To a proposal to turn the Asiatic Society into a government body there was a strong reaction:

> 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 concievable. As for ourselves we ask 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,....[21]

The practice of science was to be kept free from the influences of state or politics. Science was viewed as sacred : it was scantified. There was an appeal for 'liberty', for freedom to pursue knowledge in its own terms. The government had to be distanced from any advisory or directorial role in the Society. The government was expected to provide aid and encouragement to the Society's projects. But it had to respect 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

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[20] See Chapter I, p. 55.

[21] *I.R.*, Vol. I 1836, p. 153.

> obtaining for such societies all the aid necessary *to promote the object of their foundation....* [22] (emphasis mine).

As evidence of their desire for independence from government the Asiatic Society never became a government. organisation inspite of all the financial pressures. This attempt at maintaining a distance from state and politics was however not new to western science. It was actually practiced by scientists in Europe as well. The rules of both the Royal Society in London and the Academy of Science in Paris adopted quite independently precluded political and theological discussions. As shown by Gillispie 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.[23] In Europe where the resource base of the institutions was much stronger, it was easier to conceive of such unfailing commitments. The same aspirations in a colony adds new light to the history of 'colonial science.' It highlights one of the important conclusions that this research aims to arrive at. Science in the colony initially developed without the patronage of the colonial state and with a strong sense of independence and commitment of the scientists towards the discipline, just like their colleagues in Europe.

Here we have a very complicated relationship emerging between the colonial

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[22] *Ibid.*

[23] Gillispie, *Science and Polity*, *op.cit.*, p.550.

state and the scientists on the question of a patronage and independence. The scientists in the colony behaved in as single-minded and professional a manner as their metropolitan colleagues. Apart from both the difficulties and opportunities that the colonial situation offered to scientific work, the colonial locale and its political circumstances were largely irrelevant to them, as far as their researches were concerned.

Of course, colonial administrators would more readily fund those scientific projects that promised either direct practical benefits or at the very least an effective addition to the imperialist civilizing process. It is not that the scientists did not comply; they did, and to that extent their science became a functioning instrument of imperialism.

But at the same time, the scientists resisted subordination. They were well aware that in the long term their careers unfolded within that wider realm of science, whose terms had no necessary connection to the logic of colonialism. Thus as far as their research agenda was concerned, as far as their scientific discourse were concerned, they demanded independence. They also wanted the government to realise the wider horizons of their work and thus patronize it. They wanted the government, even a colonial one, to realise that science should be patronized not only for the instrumentalities it provided to the state but also for the love of 'truth'.

Thus it was not that the scientists did not have any expectation from the government. As I have shown, they had their expectations which the state did not always fulfil. The colonial state could not fully respect their quest for positivist knowledge and disregard of commercial projects. This gave rise to a sense of frustration and bitterness. The scientists often felt that their researches should have been showered with more recognition. Henry Piddington was very frustrated that the government was unwilling to help research on cyclones which he felt posed a great danger to human life.[24] He reacted against the state's indifference towards both science and human welfare.

> As regards the govt., 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 supiness 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....[25]

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[24] *IR*, Vol. I, 1836, pp. 155-156.

[25] Piddington, *Conversations.*, *op.cit.*, p.109.

It was not just a question of financial aid that frustrated the scientists. State recognition of scholars was not forthcoming. The Editorial of *India Review* on the eve of James Princep's departure to England had some very sharp comments to make:

> We had expected the very least, on the departure of such a man from these shores, where he had shone with such unparalleled splendour, that some public testimonials would have been made by the government whose members acquainted with the progress of science and the immense benefit of a state derives from its encouragement.[26]

The editorial goes on to add:

> 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.[27]

The utter frustration at the colonial government's lack of interest in scientific researches reflected here shows the scientists' attitudes towards the state. To a scientist, with all his desire for insulation and distance from politics and the state, what crucially mattered was the furtherance of the discipline and his intellectual recognitions. As long as support to that cause was forthcoming he was willing to work under any political regime. Recent sociological studies on the scientific communities in Europe of 18th C. and 19th C. have revealed how this insulation gave a flexibility to scientists unlike other groups like writers, artists, philosophers and social scientists.[28] Here, in this fascination for France while serving a British colony, we see the desire for a similar

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

[27] *Ibid.*

[28] The most important work on the subject is Thomas Kuhn's work *The Structure, op.cit.*, also Gillispie's work, *Science and Polity op.cit.*, for France.

insulation. This obviously had some clear reasons. Right from the end of the old Regime a great innitiative had come from govt. to encourage scientific researches in France. Infact Turgot's ministry from 1774 had started drawing upon science and systematic knowledge in formulating policies intended to rehabililate the French monarchy. Likewise during the half-century between the Turgot ministry and the revolution of 1830, the French community of science predominated in the world.[29] France thus was heralded by men of science as the true patron to their cause. The admiration of France that we see in the above passage is probably largely because of that. Similar views were frequently expressed. 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."[30]

Charles Coulston Gillispie while writing the history of science and polity in France at the end of the old Regime has shown how science was being patronized in France by the state from the late 18th C. So much so that science and polity formed a 'partnership' with one serving the interests of the other. From science the statesmen and politicians wanted intrumentalities, power in the form of weapons, techniques, information, communication and so on. The scientists in return wanted funds, institutional support, and legitimacy of their professional status. In short in contemporary France, science's role was to provide the state with the services and knowledge of experts and in return to draw advantages from the state for the

[29] Gillispie, *op.cit.*

[30] *I.R.*, Vol.I, 1836, p.152.

furtherance of science.[31]

This close association between science and the state is more a phenomenon of the world we live in at present.France alone seemed to have taken the lead in this amalgamation in the late 18th C. and the early 19th C. For England this pattern in the relation between science and polity was characteristic of later times. The Royal Society of London till the 1840s, was paralysed by a severe lack of funds with very little aid forthcoming from the government. Charles Weld writing in the 1840s showed how Dr. Humphrey Davy, President of the Royal society, tried in vain to prevail on the government. to offer science and the Royal Society some substantial support. Many of his speeches reflect how strongly he tried to convince the government of the advantage of science. In one address to the government he said:

> The progression of phyical science is much more connected with your prosperity than is usually imagined. You owe to experimental philosophy some of the most important and peculiar of your advantages. It is not by foreign conquest that you are become great, but a conquest of nature in your own country. It is not so much by colonisation that you have attained your preeminence or wealth, but by the cultivation of the riches of your own soil... Science has been a prime cause for creating for us the inexhaustible wealth of manufacture, and it is by science that it must be preserved and extended. Science for its progression, required patronage; but it must be patronage bestowed, a patronage received with dignity...[32]

The government. seemed to have been lukewarm or indifferent towards scientific research and gave it no substantial support. The disappointment and frustration from

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[31] Gillispie, *op.cit.*, pp. 549-550.

[32] Weld, *op.cit.*, pp. 466-47

such a relationship was voiced by Sir. Davy in a letter to Mr. Children:

> I am irritated by these more than I ought to be; but Iam getting wiser every day recollecting Galileo, and the times when philosophers and benefactors were burnt for their services....[33]

This bitterness of Sir. Davy was quite similar to what we have already seen from the contemporary scientists in India. The state attitude towards scientific research in the colony was similar to what was characteristic in Britain. England unlike France was yet to realize the advantages from a close association with men of science. For this reason scientists in colonial India often wished that they were serving the French empire, where they were sure of better treatment. The scientists mis-recognized the particular features and objectives of a colonial state. They did not realise that the economic compulsions of a colonial state, whether under British domination or French, would constraint the support for such researches in any case.

This contradiction between their expectation and the reality, between their hopes and dreams and their unfavourable conditions of work, deepened their frustration. Aspiring to emulate the societies and researchers of the metropolis they often found themselves helpless in a colonial world.

Thus if Sir Humphrey Davy, the president of Royal Society, was reminded of Galileo, those in India felt even worse. John McClleland tells the story of a Mr.

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[33] *Ibid.* pp. 366-367. Infact Weld a member of the Royal Society, himself comments, "In this age of progress it seems paradoxical that science, which has done so much to raise the power and rank of England in the scale of nations should be neglected as it is by the legislature and the nobility" p. 466.

Laidlaw, appointed as a geologist by the government but subsequently forgotten. There is a strong sense of melancholy in the way McClleland talks about him and accuses the government:

> 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 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 he 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.[34]

Laidlaw's career, particularly the way McClleland described it, showed the nature of depression many scientists were suffering from. In a country where any advancement in science depended on the enterprise, zeal and assiduity of individuals, rather than upon a large community, such examples often tended to discourage others to risk their fortunes and lives for a cause which was yet to be rightly valued by the state.

But to this picture there were a few exceptions. There were some cases in India where the government came forward to support research projects. The scientists found willing allies and patrons in certain colonial entrepreneurs, whose interest in science

[34] *I.R.*, Vol I, 1836, pp. 155-156.

prompted funding of products. It appears from the official despatches that government officials were not unsympathetic towards natural sciences. The Court of Directors in a despatch to Bengal in 1777 declared,

> it is at all times, our wish to consider the merits of such as (sic) act in any capacity, under our service or protection not only in the immediate branch of their stated duties or employments, but in every application that may enlarge the minds of our servants in general to liberal and useful enquiries.[35]

The Company gave financial support to the trigonometrical surveys of the measurement of Indian meridional Arc. which even the scientists agreed was purely of a scientific character, "not essential to the ruling power in the assessment of its territorial revenue".

This attention was ofcourse inconsistant and only a few inidividuals in the government took direct interest in the progress of science in India. Governor General Wellesly was convinced that,

> The illustration and improvement of that important branch of the natural history of India, which embraces an object so extensive as the description of the principal parts of the animal kingdoms, is worthy of the munificence and liberality of the English East India Company and must necessarily prove an acceptable service to the world"[36]

He established an "Institution for Promoting the Natural History of India" at his

[35] India Office Records. E/4/623. India & Bengal Despatches 16th March (sic April) 1777. f 507, Here taken from Ray Desmond, *The India Museum, 1801-1879*, OUP, London 1979, p.4.

[36] Asiatic Annual Register Vol. 9, 1807, p. 110 from Desmond, *op.cit.* p. 48.

country residence at Barackpore in 1804.[37]

How to explain these stray cases of government support ? How to explain that in some unique cases the Company did came forward to support projects with no commercial value in a colonial country? Sir. William Jones said in 1788,

> ...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 rose" and which seem to consider nothing done or learned, while anything remained unperformed or unknown,....[38]

This was how Europeans saw themselves. What Jones called the 'active spirit' was nothing but an attitude towards the earth and its habitats that western science had given rise to in Europe. It was the spirit of knowing the unknown, solving the puzzles and a confidence in the conquest of nature. It was a spirit which at times blurred the lines between the colonial state government and the scientists as both belonged to the same age. It was an age where there was a general belief that science would provide the complete knowledge of this world and the universe. It was nothing special to the 'European minds', as Jones put it, it was a situation which made the European think in a certain way. Western science shared that mental attitude.

However, inspite of these shared passions, the state and the scientists did largely remain two separate entities in early 19th century colonial India. They had very separate goals to pursue and very rarely did their interests meet. The close collaboration between the state and scientists, each serving the others interests, was a much later development in colonial and particularly post-colonial India. But in our period both were yet to realise the advantages of a mutual understanding. That realisation took place slowly and only after the nature of both state and scientific interests had undergone considerable changes in India. Science was yet to establish itself as the most powerful component of the state power a fact which most history writing on science in the colony fail to understand.

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[37] *Ibid.*

[38] *A.R*, 'The Introduction', VOl. I 1788, p.1.

PART - II

SCIENCE IN THE COLONY

CHAPTER III

The Origin and Growth of Meteorological Sciences in India.

The usefulness of carefully recorded meteorological observations was noticed a long time back by the Europeans-seamen, astronomers, medical officers, engineers and administrators. The initial scientific metereological works on Indian soil were started around the last quarter of the 18th C. from the 1780s. In this chapter I would like to sketch a narrative account of the origin and growth of meteorological studies by British scientists in colonial India. The historical narrative will cover the period from the 1780s to the time of H.F. Blanford who became the first Meteorological Reporter to the government of India in 1875. Although one of the most important meteorologists in colonial India, I would abstain from discussing Blanford's career in detail. Blanford was responsible for the formation of the Meteorological Department and the organisation of the meteorological studies in the later half of the 19th C. But the effort in the present chapter is to trace the early meteorological surveys in India which were very scattered and unorganized in nature and were being done from almost hundred years before Blanford's period. From Blanford's time scientific research in India reached a different stage. A study of the early works seems important for two reasons. First, most of the literature on science in colony trace its history only from the organized days and ignore the period of inception. Second, a study of the initial works throw some very interesting light on the motivation behind the introduction of western science in India.

This chapter would thus try to examine questions like how the atmosphere and climate of India became objects of scientific interest for the British scientists? How did India with its special environmental features help to contribute fundamentally to the metropolitan knowledge of meteorology? What improvements were made in the various instruments, and how questions of human welfare were strongly attached to maritime researches which were of predominantly colonial interest.[1]

Before going into the history of Indian meteorological studies, I would like to take up a basic question. Why did such studies originate and flourish in India at all?

Early Interest

The basic object of any scientific survey is to enable us to make 'quantitative' predictions of phenomenon, not only to foretell the fore occurance in general terms, but to predict their time and exact measure. Meteorological studies in colonial India were no exception. The basic objective was to collect data from which to determine the climatic conditions of the place, with the purpose of foretelling the approach of cyclonic

[1] The lack of secondary works hampered this chapter in a particular way. I have been unable to draw the links with European researches directly. I would have liked to place these researches in the context of an international history of meteorology but the want of adequate secondary works and also the nature of my primary sources have made it difficult to do so consistantly. I have tried to draw the links wherever it was possible like Whewell's Tidal studies or Piddington's Oceanic researches, but the chapter would largely remain a study of meteorology as it developed and shaped in India.

storms, floods etc. It is for this reason that meteorological surveys developed in Europe and particularly in the colonies where the climatic conditions were more alien to the Europeans. But the interesting fact is that behind the sudden proliferation of such studies in this country, there was one unique factor - India itself. Going through the early works of colonial Indian meteorological surveys, one has the distinct feeling that what appealed to these meteorologists was also the unique facility that this land offered to them for a variety of studies. As early as 1805, Francis Balfour wrote:

> it is natural for those who are persecuting(sic.) discoveries in medicines and meteorology to look towards 'India' for some informations respecting, the nature and peculiarities of the climate in which we live. Possessing as we do, the peculiarity of a tropical situation, with a more extensive field, and greater conveniences for making observations than any European nations, ever enjoyed before, it is an expectation which they have reason to entertain, and which on that account, and many other consideration, are ought, if possible, to gratify....[2]

Balfour goes on to discuss in detail the particular advantages that India afforded for meteorological studies. This optimism at a very early stage like this is very interesting. This tone was echoed by many others particularly for meteorology in India. Almost fifty years later, Dr. G. Von Leibig, while discussing some meteorological observations on Parisnath Hills, repeated almost a similar opinion. His report started this way -

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[2] Francis F. Balfour, "Observations respecting the remarkable effect of Sol-Lunar Influence in the fevers of India; with the scheme of an astronomical ephemeres for the purposes of medicine and Meteorology", *A.R.*, Vol. VIII, 1809, pp 6-2.

> The following discussions of a few meteorological observations made on the Parisnath Hill in 1856, I submit to the society less because they contain any new facts than with a view of drawing attention to the peculiar advantages afforded in India for the investigation of meteorological questions by the great regularity of all atmospheric changes.
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> *A few days observations in this country will suffice to trace laws, the exhibition of which would, in Europe, require months and years of continued research.*[3](emphasis mine).

Leibig went on to show the great regularity of barometric curves in India which proved the stability of atmospheric pressure. The shape of the curve of one day was so regular that the transmition was equivalent to the stabilization of a year's study in Europe.

Henry Blanford, a trained meteorologist, had more reasons to believe in this scientific claim. In the introduction to his brilliant work, *Meteorology of India*, 1877, he wrote,

> 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 conditions 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, 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

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3 Dr.G.Von Leibig, "Discussion of Some Meteorological Observations made on Parisnath Hills", *JASB*, Vol. XXVII, 1858, p. 1.

only less defined meteorological frontier excites in the zone of all but unvarying, barometric pressure of the equatorial belt.[4]

Later while talking about scientists in Europe he adds:

> It is the opinion of one of the leading meteorologists of Europe, that the contribution of India to the Science of physical meteorology, already rival those of his older sisters of Europe, and this in virtue of the extreme regularity as well as intensity of the phenomenon which India presents.[5]

Blanford went on to show how this was being gradually accepted as a scientific fact even by those in Europe. Infact as early as 1831, in one of its conventions the British Associations for the Advancement of Science highly appreciated the meteorological researches in India. The Association also agreed that researches on gradation of temperature with altitude, the diurnal oscillations of the barometer, etc., were ideal for the climate of India and proposed to supply delicate instruments for these observations.[6]

So the great geographical diversity and the stability of atmospheric pressure of India provided excellent conditions, for meteorological studies. The Indian tropical climate being very different from that of Europe became an important factor for the advancement and enrichment of the science of meteorology. Most importantly, by the

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4 Henry, F., Blanford, *Meteorology of India, Being he second port of the Indian Meteorologists Vade Mecum*, office of the supt. of Govt. Printing, 1877, pp. 3-4.

5 *Ibid.*, p. 164.

6 "Recommendations of the Sub-Committee of the British Association for the Advancement of Science", *JASB*, Vol. I, part I, 1832, pp. 306-307.

1860s, an opinion was developing among scientists both in England and India that India was making very fundamental contributions to the science of meteorology. This developing scientific consensus is important. It shows that science was not only used to exploit colonial wealth, as is assumed by many historians. Rather, a colonial country with all its environmental and physical pecularities, was utilised for the enrichment of scientific knowledge.

Early Researches

As mentioned earlier modern scientific studies of Indian climate patterns started around the 1780s. This, however, does not include the maritime surveys of storms and tides which started much earlier and which I will discuss separately. Two almost simultaneous studies launched the course of meteorological surveys in the Indian subcontinent. Colonel T.D, Pearse, about whom I have discussed before, recorded the observations of the barometer, thermometer, hygrometer, on wind directions and rainfalls during the period 1785-1788. The reports included a study of each day's weather, a consideration of the nature of sky, humidity, expectation of rain and storm etc.[7]

Henry Trail's studies predicted those of Pearse. Between February 1784 and 31st December 1785 he carried out surveys in Calcutta. The thermometer was placed in a varandah open to the Esplanade, which interestingly in those days as the report

[7] T.D. Pearse, "A Meteorological Journal from Ist March, 1785 to 28th February 1786", *A.R.*, Vol. I, 1788, pp. 441-465.

remarked, 'enjoyed at all times, a free circulation of air'.[8]

The instruments used by Trail were quite primitive. The Hygrometer, for instance, was a bit of fine sponge, suspended in a scale. The sponge was first dipped in a solution of salt and tartar, afterwards it was dried well and balanced by a weight in the opposite scale at a time when the atmosphere was most dry. The survey apart from weather charts, provided a general state of weather for every month. For example for the February of 1785 it said:

> This month the wind very variable, and the atmosphere for the most part cloudy, and sometimes several days succeeding without any sun the air also damp and cold, frequently thunder, and on the 8th there was a fall of hail in the afternoon, accompanied with thunder... .[9]

In April the report described the thunderstorm that occured in the afternoon or evening: "Before the storms begin, the clouds become very dark and Low, and the winds being thus confined between the clouds and earth must of course, be greatly augmented".[10] This was probably the first scientific account of the famous pre-monsoon showers and storms of Bengal, popularly known as 'North-Westers. Trail's Meteorological Diary also made many basic statements: the fact that in winter, the

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[8] Henry Trail, Esq., "A Meteorological diary, Kept at Calcutta, From 1st February to 31st December, 1785", *A.R.*, Vol. 2, 1794, App.331.

[9] *Ibid.*, p. 332.

[10] *Ibid.*

mercury level in the barometer is the highest showing the low atmospheric pressure, and it is the lowest during monsoons when the pressure is greatest. It also reported that in Calcutta the variation of temperature difference between morning, mid-day and evening is very trifling.[11]

This early report made some interesting observations regarding the influence of moon on weather. From an examination of one year's observations, Trail proposed that there was no general rule that the atmospheric pressure was influenced by the position of the Moon. However, he affirmed that the direction of the wind certainly has some effect on the atmospheric pressure.[12]

Here it can be mentioned that in these early years there were a lot of researches on the subject of barometric pressure and the influence of moon on it. In 1795, John Farquhar, working on it failed to establish any link and explained the regular variations of the barometer which take place in this country as something 'peculiar' to tropical climates.[13] It was Francis Balfour, who in the same year expressed a 'strong suspicion' that there was a connection between the barometric pressure and position of the moon and other planets, although admitted that his observations were of too limited a nature

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[11] *Ibid.*, p. 378.

[12] *Ibid.*, p. 330.

[13] Balfour, "A treatise on the Barometer", *A.R.*, Vol IV, 1807, pp. 190-191.

to form a theory.[14] However, by 1805 he had already developed a theory and dismissed the influence of barometric pressure on human constitution.[15] We shall discuss this in detail later.

There were other interesting works in this early period. In 1789, William Hunter recorded observations on the rainfalls and climate of Ujjain.[16] It was from the beginning of the 19th C. that systematic recordings over regular periods at a number of station became possible. At Calcutta a summary of the meteorological observations of some years was done in 1832.[17] The earlier volumes of the *Journal of the Asiatic Society of Bengal*, contain a number of meteorological Registers from various stations - Simla, Bijnaur, Bombay, Kathmandu, Darjeeling, Mauritius, Singapore, Bangalore etc.[18] In 1835, Rev. Everest published a paper on the revolution of seasons, as also on the correspondence between atmospheric phenomenon and changes of the moon.[19] In 1839 he also presented a paper on the rain and drought of the last eight seasons in

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14 *Ibid.*, p. 199.

15 Balfour, "Observations Respecting Effects of Sol-Lunar Influence", *op. cit.*, pp. 1-85.

16 William Hunter, "Astronomical Observations made in the upper parts of Hindustan, and a Journey thence to Oujein", *A.R.*, Vol. IV, 1807, pp. 141-158.

17 "Summary of Meteorological observations made at the Surveyor General's office in Calcutta during the years 1829, 1830,1831", *JASB*, 1832, Vol.I, pp.23-33.

18 *JASB*, Vol. V and Vol. II.

19 Rev. Robert Everest, "On the Revolution of Seasons", *JASB*, Vol. V, 1836, pp. 281-287.

India.[20] Major Boileau, superintendent of the Magnetic Observatory of Simla, contributed the results of his physical investigations to the *Journal*. These included tables for determining the elastic force of aqueous vapour in the atmosphere and the temperature of the dewpoint, by observations of a dry and wet-bulb thermometer.[21] Gradually from the 1830s there was a definite flowering of meteorological researches by different scientists stationed at different parts of the country.

Over these years there were certain developments taking place within the discipline of meteorology. One important characteristic of it was its association with astronomy. Meteorology, as a science of study of weather, atmospheric pressure, humidity, tides, had very important connections with the position of the sun and the moon, vis-a-vis the earth. Colonel Pearse, whose meteorological records I have mentioned before, kept a detailed record of astronomical phenomenon. He carried out a series of astronomical observations from Madras to Calcutta - which helped him in meteorological pursuits.[22]

James Kyd's study of the tides in the river Hoogly at Calcutta, from 1805 - 1828

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[20] Everest, "Remarks on the Rain and Drought of the Last Eight Seasons in India", *JASB*, Vol. VIII, 1839, pp. 313-316.

[21] J.T. Boileau, "Tables for Determining the electric force of aqueous vapour in the atmosphere and the temperature of the Dew point, by observation of a dry and wet bulb thermometer", *JASB*, Vol. XIII, 1844, p. 135-170.

[22] Pearse, "Astronomical observations in Fort William and between Madras and Calcutta", *A.R.*, Vol. I, 1788.

showed that the horizontal parallax of the moon invariably affects the tides, when that is high, tides are high and vice-versa. The parallax is highest on the second and third day after full moon, and the highest tides corresponded with these days. He charted the full pattern of tide forms.[23] In 1834 and 1836 Rev. Everest wrote two papers on the influence of the moon on atmospherical phenomenon.[24] In 1835, F. Marcet wrote a paper on the influence of moon on the weather.[25] In 1851 and 1852 ther was a series of articles by J. Middleton and J.W. Beale on the same theme.[26]

But perhaps the most important paper was that contributed by Francis Balfour regarding the influence of the moon and the sun on Indian fevers.[27] This paper was unique for two reasons. First, it combined the three important disciplines of astronomy, meteorology and medicines. Second, it provided some pathbreaking information regarding meteorology and its influence on Indian diseases. This paper also shows the significance that meteorology was acquiring within the colonial Indian scientific discourse.

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[23] James Kyd, "Tides in the River Hoogli, at Calcutta from 1805-1828, with observations on the results thus obtained", *A.R.*, Vol. XVIII, 1832, p.259.

[24] Everest, "On the influence of the Moon on atmospherical phenomena", *JASB*, Vol. III, 1839, p. 345 and "Comparison of the height of the Barometer, with the distance of the Moon from the celestial Equator", *JASB*, VOl. V, 1836, pp. 585-527.

[25] F. Marcet, "Influence of the Moon on the Weather", *JASB*, Vol, III, 1836, pp. 525-527.

[26] J. Middleton, "Influence of the moon on the Weather", *JASB*, Vol. XX, 1851, pp. 275-285.

[27] Balfour, "Observation..." *op.cit.*

Francis Balfour, who was a medical officer, made some observations in 1805, 'respecting the remarkable effects of Sol-Lunar influence in the Fevers of India." The objective of his study tells half the story. Balfour's concern was "with the scheme of an astronomical Ephemeris for the purposes of medicine and meteorology".[28] This whole project was very interesting not only for the novelty of its scheme but also because researches in medical science by 1805 had yet to start in colonial India. Balfour had actually started working on this even earlier. In 1794, he had already done a study of Sol-Lunar influence on Fevers in general, where he had come to the conclusion that, "all Fevers are liable to certain diurnal and septenary revolution, and that these revolutions are uniformly and constantly connected with fixed periods of time".[29]

By 1794, Balfour was increasingly getting interested in the influence of moon and sun on general atmosphere " where all the operations of life and nature are carried on". An understanding of this phenomenon he believed would give him a better insight into their influence on diseases, particularly in a tropical country like India.[30]

In this regard Balfour had an interesting correspondence with Mr. John Farquhar whom he asked to give some account of the regular diurnal variations of the barometer in India. Mr. Farquhar had observed three different diurnal periods of change in

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[28] *Ibid.*, p.1.

[29] Balfour, "Treatise...", *op.cit.*

[30] *Ibid.*

atmospheric pressure. Not being entirely satisfied with Farquhar's observations and deductions, Balfour continued researches on his own and came to more detailed conclusions. They were: (1) in the interval between ten at night and six in the morning the mercury in the barometer tends to fall; (2) between six and ten in the morning it tended to rise, (3) between ten in the morning and six in the evening it again falls; and (4) between six in the evening and ten at night it tends to rise. Not being able to define these fluctuations scientifically, Balfour made a guess that they were not unconnected with the relative position of the moon and other planets. What Balfour realised next was that such fluctuations were not only confined to the regions under the equator, similar fluctuations took place in the different latitudes of Europe also. This allowed him to establish a law of nature of fluctuations on a more extensive scale and he showed its general importance in respect to medicine. It showed the potential for a breakthrough in general medical sciences.[31]

But for Balfour India provided some special attractions because here he felt the connection between the attacks and remits of fever were more closely linked with the diurnal fluctuations. His purpose was to trace "a new theory and treatment of the whole class of febrile diseases".[32] Balfour first demonstrated that the influence of the attractions which regulate the motions of planetary system causes flux and reflux of the atmosphere and that exerts itself to a proportional degree on every particle on this

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[31] Balfour, "Observation...", *op.cit.*

[32] *Ibid.*, p.2.

globe. This influence was also felt on the human frame. The sol-lunar, influence manifests itself not merely on the human constitution but on the 'attacks', 'intensification', 'remmission', 'postponings and relapses' of paroxysms of fevers. These changes were coincidental in time, and correspondent in degree with the periodical changes that take place in the power of sol-lunar attractions. Balfour borrowed from De La Place's work of 1790, the theory that the moon and Sun excite periodic pertrubations on the surface of our globe. These two quantities of power, sometimes assisting and sometimes counteracting each other, according to the varying position in which they are placed, produced the corresponding change that were observed in the paroxysms of fevers. Balfour initially did his study on typhus and bilious fevers of Bengal. He later extended his study to every disease that was distinguished by febrile paroxyms. He also mentioned a letter from a doctor in Bombay who reported on similar cases in Bombay, which further substantiated his theory.[33]

Combining all these investigations and analyses he was able to construct a 'theorem' which, he claimed, served to explain in a new but satisfactory manner, the whole class of febrile diseases. The theorem, which I am going to quote was important for European doctors to study and cure tropical fevers and it also paved the path for further researches on the question of climate and diseases in colonial India.

[33] *Ibid.*, p.21.

The theorem said:

> The fluctuating force of Sol-Lunar influence coinciding and co-operating in all its various stages and degrees, with the various modifications of the paroxysm to attack in all days of the neaps and springs, and supports and reiterates them, according to various types, until the commencement of different neaps, at which junction the maturity of the critical dispositions happening to concern with the periodical decline of Sol-Lunar influence, these paroxysm then subside and came to a termination on crisis; and thus form a different successions of paroxysms constituting fevers of various lengths of duration.[34]

Balfour had further ambitious plans. He went on to prepare the scheme of an astronomical emphemeris containing a column for the hourly variations of sol-lunar power both in the day and at night. He claimed, that by this ephemeris certain general truths will at length be obtained with respect to the sol-lunar influence in the different processes of nature. This would have a number of utilities. Balfour suggested that such a knowledge might help in understanding that all the days of the months are not equally favourable for the important processes of baking, and of preserving meat, which would in turn help the packing of food in England for ships on distant voyages. He also added that in the colonies this knowledge would help in the cultivation of indigo, sugar, saltpetre and opium.[35]

Finally, Balfour concludes his paper, with a note of striking confidence and optimism. He said:

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

[35] *Ibid.*, p. 27-28.

> 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 producing important improvements in medicine and meteorology.[36]

This claim is striking particularly because, if we can recall, Francis was an Anglo-Indian Medical officer of quite an obscure background.His name was never perhaps heard by the highly influential scientific elites of Europe. Yet, placed in a tropical country, faced with phenomenon never before observed in Europe he could make a claim to such a fundamental contribution to medicine and meteorology.

There were many other contributions of the above type. In 1831, Hutchinson read a paper at a meeting of the Medical and Physical Society on 'Health and Atmosphere.' He considered that malaria and other epidemic disorders had a relationship with large scale atmospheric changes. He prepared an original theory on the constitution of the atmosphere. Although unclear about what the actual difference between the atmosphere in India and England was, he indicated that the atmosphere in India tended to reduce animal and vegetable heat, and connected this phenomenon with a peculiarity in its electrical constitution.[37]

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[36] *Ibid*. p. 29.

[37] Hutchinson, "Health and Atmosphere", *Gleanings*, Vol.III, 1831, no. 30, June, pp.190-191.

Scientists had also taken up climatic studies for treating diseases in tropical zones. Corbyn's work which came out as early as 1829 on the *Diseases of Infants of the Climate of India* was to provide instructions to parents on the treatment of tropical infantile diseases. The instructions were for Europeans residing in India and unaccustomed with its climate. Corbyn concluded that in India June to August were the hottest months and the most fatal period for children just as December and January were for those in Europe. In all principal stations of Northern India, he showed that child deaths were most frequent and sudden during the months of June, July and August. According to him the reason was that in North India, the child lived under cool winter climates until summer when the sudden occurrences of excessive heat proved fatal for the child's health. There was no time for medicine to take full effect. However, he also added that the situation in Bengal was quite different. Here the climate was not so severe and although the child suffered from various bowel complaints death was much rarer.[38] Corbyn went on to give a list of various diseases common among children in India like small-pox, measles, cholera - which according to him varied in perceptible degrees with every change of weather and temperature. He gave a detailed description of the symptoms of these diseases, how each affected the

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[38] Frederick Corbyn, *Management and Diseases of Infants of the climates of India, being instructions to mothers and parents, in situation where medical and is not to be obtained and a guide to medical men, inexperienced in the narrower and the treatment of tropical infantile diseases.* Calcutta, 1828. About the climate of Bengal as compared to North India, Corbyn provides the following case -

> It has been the case, that many families, when residing in Hindustan, have lost all their children from these sudden vicissitudes; but when their destination has been altered to Bengal, the melancholy loss of their offspring no longer ensued...p.421.

child's body and what the cures for them were.[39]

By the second decade of the 19th C. even the government had realised the importance of meteorology on understanding questions of health. All the medical offices had by that time started maintaining meteorological charts. By the middle of the 19th C. Meteorologial Reporters were regularly indicating the course to be pursued for throwing meteorological information during epidemic outbreaks particularly cholera.[40]

Meteorology and Navigation

Meteorology was intimately linked to navigation and maritime researches. Navigation was one of the early concerns of the Europeans in the distant non-European waters and thus it is not surprising that surveys regarding oceanic storms and river tides had started quite early in India.

In 1826, James Horsburgh published his major work *India Directory*, a compilation of directions for sailing to and from the East Indies, China, Cape of Good Hope, Brazil and other interjacent parts of the world. It was completed under the

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39 *Ibid.*

40 Course to be pursued for procuring meteorological information during cholera outbreaks. " From Colonel W.K. Burns, Secy. to the Government of India, Military Department, To the surgeon general Her Majesty's British forces in India. To the surgeon general Indian Meteorological service, Bengal dated 11th January, 1877 Sanitary, Home Department Proceedings January, 1877.

auspices of the Court of Directors of the United East India Company. The compilation was made during twenty two years of navigation in those seas and contained detailed information about winds, tide patterns and storms.[41]

But this work, important though it was, falls into the older pattern of writing on storms and seas, which tended to only provide descriptions of natural phenomena. By the 1840s, a completely 'new science' of the study of oceanic storms, was emerging where Henry Piddington's contribution remained central. This new science not only kept records of these phenomenon, but also tried to provide explanations for them. These explanations were based on mathematical demonstration through charts and diagrams of these storms and wind patterns. As Piddington argued, such a study was much more reliable as it tended to predict the weather and natural phenomenon more 'anthentically'.[42] However, this new science was being developed by the scientists, and the sailors continued to believe in the older observations which were much more simple to understand. Infact, Piddington's works show this interesting conflict between the sailors and the scientists, the former often rejecting the new form of knowledge as

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[41] James Horsburgh, FRS, *An India Directory, or Direction for Sailing to and from the East Indies, China, New Holland, Cape of good Hope, Brazil and the interjacent parts: Compiled chiefly from original Journals at the East India House, and from observations and remarks, made during twenty two years experience of navigation in these seas*, Third Edition, London 1826.

[42] Henry Piddington, *The Horn-book for the law of storms; for the Indian and China seas*, Calcutta, 1844. and *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.

a 'new fangled science'.[43] Piddington in his various works tried to make the new science commonly understood and accepted. His *Conversations about Huricanes* which I have mentioned before, is a typical example of such an effort.[44]

Along with this general development of this science, observers were also perceiving that the tropical regions had a peculiar wind pattern. In Dr. Blane's *Account of the Hurricanes* of 1780 at Barbados, it was noticed that the wind blew all round the compass, a circumstance which distinguished the hurricane from all other gales. The early navigators' and travellers' accounts often directly or indirectly spoke of the violent storms of the tropics as 'whirlwind'. In a work published in 1801, Colonel Capper, speaking of the Madras and Corromondal coast as well as the Malabar coast hurricanes, observed that the wind instead of blowing in a straight line, blows in circles or rather in one great whirl more or less circular. A French author Romme, in a work of much research, published in 1806, described the typhoons of the China sea about the Gulf of Tonkin as a "tourbillon" (whirlwind). He also described the veering of the winds in the hurricanes of the Bay of Bengal. An American, William Redfield had his attention drawn to the subject in the course of his professional pursuits as a Naval Architect, and in 1831 published a valuable paper in *The American Journal of Science* on the 'progressive' nature of these whirlwinds. In 1838, Col. Reid of the Royal Engineers confirmed Redfield's views and sought to prove them by investigations of the

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[43] Piddington, *The Sailor's Horn-Book.,op.cit.*, pp. 324-326.

[44] See Chapt. I, p.49.

West Indian Hurricans and those of Southern Indian Ocean.[45]

It was Henry Piddington who gave a final shape to all such studies and scientifically defined the storms and whirlwinds through his detailed studies of many years. Infact he proposed the term 'cyclone' for these whirling storms, not, he said "

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[45] Piddington, *The Sailor's... op.cit.*, pp. 1-5.

Piddington infact gives an entire list of works on storms.

"1. Capper on Winds and Monsoons, London 1801.

2. Papers by W.C. Redfield Esq. of New York, in the American Journal of Science and (English) Nautical Magazine from 1831 to 1848.

3. papers by Lieut. Ejnans, R.N. Nautical Magazine and Pundy's Atlantic Directory, 1838 to 1839.

4. Professor, H. Done of Berlin, Renewal papers.

5. Colonel Reid, Attempt to Developed the law of storms, final Edition, 1838, record in 1841.

,Disquisition read to the British Association, August 1838.

6. Dr. Brewster; in Edinburgh Review of January 1939. vol. 68.

7. Captain Basit Hall, in Foreign Quarterly Review of for April, 1839.

8. H. Piddington, Eighteen memoirs on various storms, Journal of the Arabic society of Bengal Vol. VIII, 1839, Vol. XVIII, 1849.

,Notes on the law of storms,for the use ofExpedition to China, presented to the govt. of India, two editions.

,The Horn-Book of storms for the Indian and China seas, Three edition, 1844 to 1847.

9. ,Sailor's Horn-Book for the law of storms for all parts of the world, two editions, first n 1849.

10. Professor J.P. Erpy; The philosophy of storms, Barton and London, 1841.

11. North American Review, No. 123 April, 1844.

12. Alex Thom, M.D., H.M. 86th Foat Inquiry in the nature and course of storms, london 1845,

13. Commander A.P. Ryder, R.N., Practical Rules to escape from a hurricane, deduced from the ratory theory established by Co. Reid. London 1847....", etc., pp.6-7.

as affirming the circle to be a true one, though the circuit may be complete, yet expressing sufficiently the tendency to circular motion of these meteors."[46] He also wrote a number of books on this subject. In 1844, he collected the results in a small book, *The Horn-Book for the Law of Storms for the Indian and China Seas.* Written by a seaman for seamen, it dealt with the subject in a thoroughly practical way. This book probably led to the appointment of its author as president of the Marine Court of Enquiry at Calcutta. In 1848, he published, *The Sailor's Horn-Book for the Law of Storm*, on essentially the same lines as the preceding pamphlet but much enlarged, and with fuller details. As a practical work it had a great success, ran through six editions and continued to be, within its limitations, the recognized book on the subject for 30 years.

However, it is his 'Memoirs' which was the most important contribution to the field of Indian Meteorology and oceanography. Without any sophisticated gadgets Piddington had to involve himself in tracing the track of the cyclones, which was of

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[46] *Ibid.* p.10,

> "I am not altogether averse to new names, but I well know how sailors and indeed many landsmen, dislike them; I suggest however, that we might perhaps for all this last class, of circular or highly churned winds, adopt the term "Cyclone" from the Greek κυκλος (Which signifies amongst other things, the coil of a snake), as neither offering the circle to be a true one, though the circuit may be complete, yet expressing sufficiently the *tendency* to circular motions in there metals. We should by the use of at the able to repeat without confounding names which may express straight or circular winds - such as "gale", storm, hurricanes", C - with those which are more frequently used (as hurricane) to designate merely their strength.".

great importance for navigation, by collecting informations from different ships. This was difficult as many of the sailors did not understand his project and often had to be repeatedly requested and almost beseeched. Even after this the reports were often frustrating and the logs of these ships faulty. Above all there was the lack of support and even direct discouragement from the government.

Inspite of this, Piddington made some very significant observations and important contributions. Particularly in the Andaman Sea, regarding the tracks of Cyclone in narrow and confined seas, about which he himself mentioned that the knowledge of European Science was still uncertain. He noted that cyclones in this sea passed close to, or perhaps over, two volcanic Islands, Barren Island (from which there was an eruption in 1852) and Narcondom. He raised the important question which later meteorological studies have recognised as valid, whether the islands were simply mechanical obstacles disturbing the regular motions of the air in its cycles or whether they as volcanic foci exercised some peculiar influence on the electric disk of the cyclones.[47]

In these navigational and cyclonic studies the connection with commerce and colonialism becomes very direct. Navigation and maritime expeditions were one of the most important components of Europe's imperial dominance over the rest of the world.

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[47] Piddington, "A twenty second memoir of the storms of the India and China seas; Cyclones and Tornadoes of the Bay of Bengal from 1848 to 1852" *JASB*, Vol. XXIII, 1854, p. 43.

Through these researches the scientists were taking part in that process of colonialism and contributing to it in their own ways. This connection between scientific researches and the process of colonialism is very apparent. But is that all? Did Piddington involve himself in a study of storms only because he wanted to serve the Empire? Whatever the nature of his work, his scientific texts actually defy such a direct connection. It reveals other concerns that he had in mind. Infact while talking about his project and complaining against government apathy he did not mention the potential commercial benefits that the Empire could earn from them. Piddington had two clear concerns for his projects, one is scientific and the second which was more predominant, was human welfare. He believed that such studies were of great scientific interest to naturalists and meteorologists. He was certain that the men of science in Europe would support such projects.[48]

Humanity or concern for human life seemed to be his most important concern. On many occasions he had justified his works as serving that human purpose. Once asking for co-operation from the sailors and government, he said:

> The Cyclone in all its various forms, and in all the parts of the world in which it prevails, is not perhaps less a scourge to human life (and we will leave out property) than the scurvy of the old...
>
> As a mere question of humanity then, we claim on this the highest ground, the support of all, whether sailors or

[48] Piddington, *The Sailor's ... op.cit.*, p. 325.

landsmen.[49]

He added that those who come forward to help would be counted as the "noblest benefactors of the human race". These purely scientific and humanitarian arguments must not have interested the colonial government which explaines the lack of future support for these projects.

After Piddington's death, G. Von Leibig took up his project and in the 1858 issue of the *Journal* he gave an account of a cyclone in the Andaman Sea, which occured on the 9th to 10th August, 1858. [50]

Apart from cyclones, there were other oceanic studies done by British scientists. In 1820s G.A. Princep made some marine observations in the Atlantic and Indian Oceans. His objective was to understand two main problems namely, "the saltiness or specific gravity, and the temparature of the ocean on different parts of its surface".[51] He compared his numerous observations with a series made by Dr. A Russell and

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[49] *Ibid.*, p. 326.

[50] G. Von. Leibig, "Account of a Cyclone in The Andamen Sea, on the 9th and the 10th April, 1858", *JASB*, Vol. XXVIII, 1858, pp. 323-337.

[51] "Abstracted Results of Marine observations" made by G.A. Princep. Esq. and detailed in a letter of 7th March 1823, Bombay; in Extracts from the proceedings of the Bewares corresponding society, No. III, Meteorological Journal", *A.R.*, Vol. XV, 1825, App XV-XVIII.

J.Princep, his brother, during their passage to India in 1819 and another one by Captain Weyhton. The deductions he reached were that in both Atlantic and Indian Ocean, the regions near the tropics were the saltiest part and the equator the least. The uniform specific gravity of the seas all over the world which appeared from this study, Princep wrote, could be of little help to navigation, except in pointing out the proximity to the mouth of rivers, which diminished the saltiness to a great degree. A knowledge of the temperatures of the oceans was more important for sailors. Princep's report provided information about the connection between temperature and oceanic currents. The report stated a fact of interest for scientists that these great oceans of the earth did not present an average or equal temperature as believed before. The Atlantic, he showed, was colder than the Indian Ocean which inturn was colder than the Pacific. He added that all these discrepancies could be explained by due attention to prevalent winds and currents as well as by the study of depths of the sea-bed.[52]

In 1856, A. Cambell made an interesting study in this regard. He studied the temperature of the surface of the ocean from the Hooghly to the Thames. Describing his projected he wrote:

> On leaving India for England in February 1856, I received...two Thermometrs from government to enable me to keep a register of the Temperature of the Ocean for Mr. Schlagintweit, and the Asiatic Society. I kept the register faithfully all through the voyage from the sandheads of the

[52] *Ibid.*, pp. XV-XVI.

Hoogly till we entered Thames...[53]

Apart from these oceanic studies there were a series of tidal studies being done in India at different river mouths. The earliest register of Tidal Observations extant in the country is that of the day and night tides in the Hugli around Kidderpore, from 1805 to 1828, by James Kyd, the founder and then proprietor of the Kidderpore dockyard. It was his profession which enabled him to do such studies, which he did on his own interest, and laid them before the Asiatic society in the trust that they may prove interesting.[54]

Kyd drew the height of the tides in diagrams, showing the state of the river hooghly throughout the year. He gave warnings about the strongest flood tides, and the high rise of the tides which took place in March, April, May and June. He also provided a study of the bores and issued a warning against the rare but dangerous night bores.[55]

Dr. Whewell in England was involved in the investigation of the general co-tidal lines on the surface of the globe. It was for his project that in 1835 he published an

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[53] A. Cambell, "A Register of the Temperature of the Surface of the Ocean from the hoogly to the Thames", *JASB*, Vol. XXVII, 1858, pp.170-175.

[54] Kyd, 'Tides in the River Hoogli...", *op.cit.*

[55] *Ibid.*, pp. 263-265.

article to encourage those in India and nearby to substantiate his studies. The article provided suggestions for those who had the opportunity to make or collect observations on the tides, at their place of residence. [56]. A few years later he published another memoranda in *India Review* for the same purpose. The tide observations, he wrote,

> will not only serve the beneficial purpose of ascertaining the tide establishment along the coast of India, upon a consistent basis with each other, but will also give the most important assistance to those philosophers who are now engaged in the investigation of the heavy of tides......[57]

These suggestions were taken up by different people in the different parts of the world. Observations were received in conformity with these suggetions and were published in the Journal between 1837 and 1850. Mr.J.Dias studied the daily tides at Singapore from the 1st of Sept. 1834 to 31st August 1835. [58] Dias was actually working on quite an ambitious plan to draw the tables of the daily ides at one or two principal stations on the long range of coast from Singapore to Chittagong, this was actually in conformity with whewell's global scheme.[59] Around the same time Lieut

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[56] W. Whewell, "Semimenstrual inequality of the tides. Extract from a letter". *JASB*, 1835, Vol.IV, pp. 517-518.

[57] Whewell, "Memorandom Respecting Tide Obsservations" *IR*, Vol.III, August, 15, 1838, pp. 303-335.

[58] J. Dias, "Daily Register of the Tides at Singapore from the Ist September 1834 to the 31st August 1835, inclusive", *A.R.*, Vol. XX, 1836, pp. 201-203.

[59] *Ibid.*

Siddons had started his studies of tides, at Chittagong itself. Many others like W.T. Lewis of Malacca, Mr. C.B. Greenlow (Secy. of the Marine Board) from Balasore, Dr. Bannister at Madras, M. Bedien from Pondicherry, Sir. R. W. Horton from Trincomalee (Ceylon), Mr. Wathern from Bombay etc. were sending their reports.[60]

Other Studies And The Problem of Instruments

Apart from these, meteorological surveys were coming up along with other trigonometrical and geological works. Messrs. Schlagintweit, who conducted a magnetic survey from 1854-1858, published their reports in the *Journal*. These reports contained a great variety of observations - geographical, meteorological and geological.[61] James Princep while preparing the meteorological Journal of Benares, made some interesting, observations on the barometeric readings in the different parts of the country which gave him the relative altitudes of these places. He found that the height of Calcutta was lower than Benaras by 2467 feet, Kanpur was 1333 feet higher than Banares, and Almorah was 4838.75 feet above Benares and so on.[62]

With all these various types of researches the question of instruments became

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[60] Whewell, "Memorandum...", *op.cit.*, p. 305.

[61] Herman Schlagintweit, "Report on the Proceedings of the Magnetic Survey from January to May 1856", *JASB* No. VI, Vol. XXVI, 1856 pp. 559.

[62] James Princep, "Extracts from Proceedings of the Banaras, Corresponding Society, No. III, Meteorological Journal", *A.R.*, Vol. XV, 1825, App. VII-XII.

very important. Meteorology is a science of studying natural phenomenon in experimental conditions - influenced by Baconian principles. This particular thrust towards observations under certain conditions, made the use of instruments for such researches very important. Even the basic observations of temperature or rainfall were dependent on instruments like thermometer, hydrometer etc. In this the scientists in India faced a major disadvatage. Lack of proper instruments was a problem which hampered research. The government on its part was not keen to spend money on importing new instruments from England. The scientists made repeated appeals for them but with little effect. But at the same time this problem provided an incentive to develop their own instruments in India when supplies from England were not sufficient.

Hygrometer which is used to measure humidity of the air was an important instrument. In 1811 Lieutenant Henry Kater wrote an article in the *Asiatic Researches* about a very simple Hygrometer which he had invented in India. He prepared it, as he claimed, from a species of grass, found in Mysore and Carnatic and called "Oobeena Hooloo" in the local language. Quite accidentally he found that this grass had an extreme sensitivity to moisture and as he needed a hygrometer for his researches, he constructed one from this grass.

The hygrometer was found to be extremely moisture sensitive. If a finger was brought near it, Kater wrote, the index shifted eighteen divisions. It was, he claimed, extremely suitable for registering micro changes of moisture in the atmosphere.[63] In the same volume of the journal, Kater wrote again about the inprovements introduced in the hygrometer.[64]

Extremely satisfied and confident about his discovery, Kater made claims very similar in tone to that of Balfour and many other colleagues. He believed the grass discovered by him in south India was more sensitive to water than anything hitherto known.

> This grass appears to be far superior to any other hygroscopic substance, hitherto discovered. In the 'Encycopeadia 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,.....[65]

It can be added here that Lt. John Warren, while experimenting in Mysore in 1804 about the effects of Terrestrial Refraction, found this hygrometer to be very useful for their purpose of measuring the moisture content of the air which caused

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[63] Lieut, Henry Kater, "Description of a very sensible hydrometer", *A.R.*, Vol. IX, 1811, pp.24-31.

[64] Kater, "Descriptions of an improved Hygrometer", *A.R.* ,Vol. IX, 1811 pp. 394-397.

[65] *Ibid.*, p. 397.

refraction of sunlight.[66]

There were certain interesting developments on the manufacture of Barometer, (used to measure atmospheric pressure) as well. In 1837 William Gilchrist, of the Madras Medical establishment developed a self-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 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.[67] A year later he claimed to have simplified the apparatus even further.[68]

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 deranged as a result of the entry of the air, and the 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 in India where once air had

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[66] Leut, John Warren, "An account of experiments made in the Mysore country, in the year 1804 to investigate the effects of terrestrial Refractor", *A.R.*, Vol. IX, 1811, pp.1-23.

[67] 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.

[68] Gilchrist, "Description...", *op.cit.*, pp. 17-18.

entered the tube the instrument became useless as only the maker of the instrument who was 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.[69] Both his suggestion came out in *India Review* and were accompanied by detailed sketches.

Lieut. R.S. Shortrede also tried to remove certain shortcomings of the conventional barometer. About freeing the tube from atmospheric air he suggested a method which did not require boiling. 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.[70] He also suggested certain solutions to the problem of gradation in the thermometer.[71]

Charles Hudson's developments on the water barometer were to ensure it of permanent utility by removing the danger of accidents and disruptions. His discovery 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 expansibilty and could correspond equally well with water, air or mercury. Above all

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[69] *Ibid*

[70] Leut. R. Shortrede, "On the Errors to which the Barometers in liable", *Gleanings*, Vol III, 1831, no. 26, February, pp 51-54.

[71] Shortrede, "On the Errors of thermometer and on a correct method of graduation", *Gleanings*, Vol. III, 1831, pp. 87-88.

the expense to construct it was also to be small. Infact, Hudson was hopeful of procuring a patent of it.[72]

James Princep was also involved in constructing various astronomical and meteorological instruments. In 1823, he constructed a pluviameter (to register the fall of rain) and an evaporatmeter (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.[73] 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.[74] In July 1836, he contributed a paper in *JASB* titled, "Experimental Researches on the Depression of the Wet-Bulb Hygrometers."[75] He devoted a great portion of his time and attention to the abrogation of the wet-bulb indications.

Many of these suggestions and inventions of instruments were tested by fellow scientists in the colony and were found to be satisfactory and particularly suitable to

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

[73] Princep, "Descriptions of a pluviameter and on Evaporation constructed at Benaras" *A.R.*,Vol. XV, 1825,Ap.Xiii.

[74] "Determination of the constant of expansion of the standard 10 Iron Bar of the great trigonometrical Survey of India. some approaches", *JASB,* Vol II, 1833, pp. 130-143.

[75] "Experimental Researches on the Depressions of the Wet-Bulb Hygrometers". *JASB* Vol. V, 1836, pp. 396-432.

researches in India. These discoveries show an interesting side of science in the non-European countries. It shows that the scientists overcame the particular problems of practising science in a non-Western country with remarkable zeal and industry and developed instruments particularly suitable for their work. This capacity to adjust and improvise was an important factor in the spread of western since in non-western world.

The Later Phase

Gradually, by the mid 19th C. we come to a period when the meteorological studies were being done in a much more organised manner, reports were becoming regular and increasingly done under government instructions. This was a major shift. In 1865, a Meteorological Committee was appointed at Calcutta "to consider the best means of establishing a system of observation for the protection of that part".[76] Soon, meteorological reporters were appointed to the government of the Punjab (A. Neil) and the N.W. Provinces (Murray Thomson). In 1867, H.F. Blanford, who was professor of Natural Sciences at the Presidency College in Calcutta and who later was to play a significant role in the evolution of the meteorological department, was appointed as meteorological reporter to the government of Bengal. [77]

[76] D.M Bose, S.N. Sen., B.V. Subbarayappa (eds), *A Concise History of Science in India*, INSA, New Delhi, 1971, p. 501.

[77] *Ibid.*, p. 503.

Though the work done by the different meteorological stations was indeed considerable and useful, necessity arose for establishing observatories, in select parts of the country. Between 1865 and 1871, such observatories were established, and their work comprised collecting as well as recording of the atmospheric data, issuing of cyclone warnings well n advance. The Alipore observatory at Calcutta was also determining correct time for the benefit of ships and telegraph offices by recording transit observations of stars.[78]

In 1875, Blanford became the meteorological reporter to the Government of India.[79] From organisational perspectives, this period, dominated by Blanford, marked an important break in the history of Indian meteorology.

Blanford was secretary of the Asiatic society from 1864 to 1868. He contributed in 1871, a note on the error of the Calcutta standard Barometer compared to those of Kew and Greenwich. [80] By that time organizationally the time had come to conceive of an all India meteorological institution. In 1875, the Indian Meteorology Department was established with a view to consolidate the work of provincial organisations. The chief function of the department included experimental observations, preparations, of daily weather charts, issuing weather summaries, seismological studies,

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[78] Blanford, "*Meteorology of India..op.cit.*, p. 42.

[79] Bose, *op.cit* ., p. 503

[80] Blanford, "Note on the error of the calcutta standard Barometers at the Kew and Greenwich standards". *JASB,* 1871, Vol.XL(2), pp.446-449.

solar physics and terrestrial magnetic studies.[81]

The *JASB* contained Blanford's observations of the irregularities of atmospheric pressure in the Indian Monsoon regions, besides a paper on "Comparison of dewpoints temperature" and another on the "physical explorations of the inequality of the two semidiurnal oscillations of barometric pressure".[82]

However, as I have stated at the beginning, the thrust in this chapter lies on the earlier unorganized survey works, carried out mostly on the personal initiatives of the scientists. Blanford's contributions were a shift from that. But why is there the need to study these earlier works? What more do they have to contributes to our understanding of western science in British India? The answer would be the conclusion to this chapter.

Conclusion

The whole question is linked to a historiogrpahical issue. The historiography arguing commercial imperialism being the sole factor behind the introduction of western science in India do not analysis these early works enough. It generally tends to depend more on the works done under government instruction in a more organized way. Such

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[81] Bose, *op.cit.*, p. 504.

[82] Blanford, "On certain protracted irregularities of atmospheric pressure on the Indian Monsoon regions, and the relation to variations of the local rainfall", *JASB*, Vol. XLV, 1876, pp. 27-47.

an approach certainly demonstrates the relationship between science and state in a straight forward way. This historiography is actually quite uncomformatable with these early individual pursuits which makes the picture more complicated. Often it is very dismissive about these works. Sangwan, in his study wrote:

> The major disadvantage of individual enthusiasm was the unavoidable of overlapping, which restrained professionalism in different branches of science. The result was that much of it was of *slight nature*. Collections were made, expeditions described, and papers written by men who pretended only modest scientific background. Articles of this kind often revealed no creative effort and they was frequently little more than description of the flora and fauna.[83] (emphasis mine)

The early individual works certainly showed certain characteristics of science in a colony which pose important questions for this model. I have shown that they were carried on by amateurs out of their own interests. Although they were serving the Company, they had no instructions from the government to do such researches. They did them out of their own interests and personal endeavours under with the guidance from Asiatic Society. If we look into the way meteorological studies were being gradually introduced in India, we actually fail to trace any clear commercial motive behind them. Even Piddington's studies of cyclones were to serve the purpose of humanity and not commerce. The linkages with colonialism thus cannot be established directly, not atleast from these scientific texts. It is true that the government started taking interest in the meteorological researches and realised the commercial and other advantages from it but that was only after such studies had been carried out in this

[83] Satpal Sangwass, *Science Technology and coloniation, op.cit.*, p. 4-6.

country by these men for almost seventy years. The concerns of the early scientists were human welfare, health, or search for 'pure' scientific.

And as for as these researches being of 'slight nature', in concerned I would like to quote from Blanford's famous work '*Meteorology in India*. Writing at a time when professional organized surveys under him were increasingly replacing the earlier forms, he paid a tribute to these early works. After talking about his plans of organized researcher he wrote :

> But there are some kinds of special enquiry which can hardly be treated as matters of 'routine', and which require more knowledge and judgement than can fairly be expected from those persons who are interested with the registration of meteorological observations merely as a subordinate part of their official duties. And, on the other hand, such enquiries are more suited to the circumstances of amateur observers.....
>
> My object in this final chapter will be to suggest certain fields of enquiry, in which amateurs if so disposed,may render good services, and which demand that knowledge and judgement which are hardly to be looked for elsewhere than in the men of science, whether professionals or amateaurs, that the latter may contribute work of the highest value to the advancement of meteorology is proved by the labours of such men as James Princep, Colonel Sykes, Gen. R. Strachey, and Dr. Henessy, and it is to be hoped that others may yet tread on their footsteps, doing their work with the same intelligence of purpose, the same keen questioning research for the explanations of the obscure and for laws which are unknown, as have prompted these and similar worthier in the pioneering days of Indian science.[84]

[84] Blanford, "*Meteorology of India*", *op.cit.*, p. 165.

The particular research interests and commitments with which those men engaged themselves make them significant contributors to the colonial history of science. The whole perception of 'sacrifice', 'disinterested quest for knowledge' enabled them to do surveys in those early days which were quite unique and pioneering.

It can be also added here that through their researches it was also being realised among scientists in Europe, that India was a potential zone for meteorological research. This shows two things, first, their works in meteorology were appreciated quite widely. They had attracted a lot of attention towards this country. Second, and very importantly, the attention they tried to or actually did attract towards India as a potential zone for research was clearly scientific in nature. They claimed that India could cause significant progress in the science of meteorology. A claim which the existing literature on that period would find difficult to explain.

CHAPTER IV

The Science of Geology in Colonial India.

> What a glorious privilege it would be, could we live back, were it but for an instant -into those ancient times when these extinct animals peopled the earth!
>
> \- Hugh Falconer, 1840s.[1]

For its associations with mining and mineral researches, geology has often been seen as the ideal scientific instrument for colonial exploitation. From the middle decades of the nineteenth century, it is suggested, geology has been an instrument of imperial development, a component of the more widespread phenomenon of Britain's economic, cultural and technological expansion. Robert A. Stafford, in his article "Geological Surveys, Mineral Discoveries and British Expansion, 1835-71" has argued that as the industrial revolution of Europe accelerated, economic dependence on knowledge of the earth's structure and mineral resources intensified.[2] To meet this demand, early nineteenth century British geologists reformed their discipline into an empirical system based on field observation. They concentrated on stratography - the chronological ordering of the layers of the earth's crust - and its essential adjunct paleontology, as a pre- requisite to objective theorising about the process governing the

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[1] Murchison, *op.cit.*, p. Li

[2] 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.

makeup of the crust. Similar opinion is expressed by other historians like Roy Porter in his articles.[3].

Historians writing on the history of geological sciences in British India in the early 19th century concentrated on the economic and commercial role of this discipline. Geological surveys were seen as 'enterprise', a profit-oriented mission divorced from 'pure' research. The historiography looks at these surveys from the perspective of the colonial state. The vested interests of the colonial state shaped the nature of these researches, gearing them for pecuniary gains. Deepak Kumar writes, "the economic value of the geological investigation proved of immediate concerns to the East India Company with the coal fields of India looming large."[4]

Moreover, much like Stafford, Kumar also sees the scientific developments in European geology from a very utilitarian perspective. He writes that the developments of the 18th century had gone a long way to integrate science firmly into the production mechanisms. The intellectual atmosphere of the 19th century was dominated by the rising class of manufacturers.[5]

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[3] Roy Porter, "The Industrial Revolution and the Rise of the Science of Geology", In M.Tech and R.M. Young (eds), *Changing Perspectives in the History of Science*, London 1963, pp 320-43.

[4] Deepak Kumar, "Science, Resources and the Raj : A case study of Geological works in the Nineteenth Century India", *Indian Historical Review*, Vol. 10, 1988-89,p. 67.

[5] *Ibid.*, p.66.

One striking aspect of the this historiography is, as discussed before, that it considers industrialisation and colonisations, the two major economic developments of the period as structuring the minds of those connected with science. Such a view does not allow much space to any other motive that might have influenced the discipline in Europe and particularly in a colony. This obsession with economic factors eliminates other perspectives and restricts the possibility of a more complicated reflection of the times in scientific works.

This approach overlooks some important aspects of 19th century geology. Geology, the scientific study of the history 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 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 understanding of rocks and fossils, analogous and complimentary to the great chain of being known in contemporary natural history.[6]

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[6] The two important books in this regard are, Nicholas A. Rupke's *The Great Chains of History; William Buckland and the Enlish School of Geology (1814-1849)*, Clarendon Press, Oxford, 1983 and Charles Coulston Gillispie's *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.

Such studies started in France and Germany towards the end of 18th C. During the second decade of the late 19th century, however, a school of historical geology began to form at the University of Oxford. Its moving forces were William Buckland and a circle of colleagues among whom William Daniel Conybeare was the most outstanding figure. During the 1820s the English contribution to the study of earth history began to rank among the finest and most sensational internationally.

Along with this success, geology as a science in England rapidly rose to high status. The geologists at Oxford and Cambridge were now counted among the most famous scientists in the country. In a little more than two decades geology as earth history with the aid of inductive philosophy had climbed from the pedestrian level of natural history to the very top of the hierarchy of scientific knowledge. Herschel in his *Preliminary Discourse on the Study of Natural Philosophy* (1830) wrote, "geology, in the magnitude and sublinking of the objects of which it treats, undoubtedly ranks in the scale of sciences, next to astronomy".[7]

It was in the same period that there were important dimensions of change in European scientific elites' understandings of themselves and their relations to the rest of the globe. It was marked by an orientation towards interior exploration and the construction of a global scale of meaning through the descriptive apparatus of natural history. It is in the light of such a consciousness and the growing prestige of geological

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[7] Rupke *op.cit.*, p.181.

science that I would like to study the geological surveys done in the early 19th century. British India. Geological sciences were introduced to India around the same time that these above mentioned philosophical changes were taking place around this discipline. The attempt here would be to see whether such thinking influenced the researches in India. The growing endeavour among scientists of Europe to prove their theories at a global scale could have led to such interests being pursued in India too. It would be interesting to find such a link because that would open up new dimensions to the study of geology in India. Interestingly, scientists in England, were apprehensive of the economic use of geology. A remarkable illustration of the lowly image of economic geology was Buckland's negative refusal to give a lecture series at the Royal Institution on economic geology in 1823. He thought that the acceptance, "might compromise the dignity of the (Oxford) University".[8]

During the period 1820-60, numerous surveys by natural history enthusiasts were done in different parts of British occupied Indian sub-content. The nature of these rock surveys and paleontological studies draw close similarities with their European counterparts. My interest in this chapter would be to see howfar the contemporary European geological ideas had become a part of British Indian geological agenda. Without reducing the importance of the commercial interests involved, an attempt would be made to see what other interests.influenced the scientists in the perusal of paleontological and rock formation surveys in India.

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[8] *Ibid.*, p. 18.

Growth of Geological Researches

First, I would like to give a brief sketch of those surveys and studies carried out in colonial India which were of particularly little commercial interests. This will give us an idea of the extent and nature of these works in India. This in turn would serve as my basic material on which I would base my arguments.

Clementz Markham gave an account of the geological surveys carried out in India. Apart from that the pages of the various journals were filled with reports of such surveys. McClleland in his book,*Some enquiries in the Province of Kumaon,...* gives an account of the earliest surveys done in the east, "either to improve the resource of our new empire, or to extend the boundaries of science". There were different papers by Gerhardus Konig, James Anderson on the coast of Coromandel (1797), Carl Peter Thurnberg in 1785 in Ceylon and by Geargius Jasephus Kamel in Phillipines etc.[9].

Particularly from the early decades of the 19th C versatile European naturalists, medical men and engineers were, in addition to their own jobs, actively engaged in geological investigation in the Deccan, Central and North India and the Himalayas. There have been many geological reports on various Indian districts in the years preceding the establishment of the Geological Survey.

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[9] The information in from a review of John McCelland's, *Some enquires in the province of Komaon relative to geology and other Branches of Natural Science*, Thacker and Co. Calcutta, in *I.R.*,Vol. I, 1836, p. 155.

Stratiographical surveys were the first form of geological surveys to be carried out in India. When Sir George Everest first joined Colonel Lambton in 1818, he had with him, as a colleague, Dr. Voysey, who was the surgeon and geologist to the survey. According to Markham this was probably the first official appointment of a geologist in India. He accompanied Everest in his severe work in the Godavari and was one of the earliest writers on the rocks of Deccan.[10] He explored Nalla-Malla mountains between Cumbhum in Cuddappa district and Amrabad and north of the river Krishna, and wrote an interesting paper on the diamond mines of southern India.[11] He also wrote a paper on the building stones of Agra and petrified shells in the Tapti valley.[12]

Dr. Voysey was followed by various other observers who reported on the rocks and minerals in different parts of India. Captain Dangerfield noted the geology of Malwa and Captain James Franklin while executing the topographical survey of Bundelkhand in 1828 also reported on its geology. He described the great sandstone formation, now known as the Vindhyas. He also noticed the great trap formation, which covers such an extensive area in the Deccan and the Malwa plateau and forms one of

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[10] Clementz Markham, *A Memior of the Indian Surveys,* Second ed., W.H. Allen and Co. London, 1878,p. 207.

[11] Dr. D. W. Voysey, "On the Diamond Mines of Southern India", *A.R.*, Vol. XV, 1825 p. 120.

[12] Voysey, "On the Building stones and Mosaic of Amrabad and Agra", *A.R* Vol. XV, 1825 p. 429. and "On some petrified shells found in the Gawilerh Range of hills in April 1823", *A.R*,XVIII, 1829,p. 187.

the most striking features in the geology of India.[13] Lieutenant Finnis brought before the society in 1829, a geological description of the country between Nagpore and Hoshungabad. In it he divided the country into four parts according to the lithology of the rocks he met with[14]. Dr. Adam described the rocks of Bundelkhand.[15].

Mr. J. Hardie of the Bengal Medical Service, also worked on the geology of central India. He classified the rocks under different heads.[16].

P.M Benza, Surgeon of the governor of Madras, contributed a paper on the geology of the Nilgiris, which may be considered as the southern termination of the western ghats, here terminating in almost vertical precipices, and which rise abruptly from the table-land of Mysore.[17] Dr. Malcomson, also of the Madras Medical Service, who was one of the earliest and ablest contributor on geology of India, and especially

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[13] Capt. James Franklin, "On the Geology of a portion of Bundeelkhand, Boghelkhand, and the districts of sagar and Jabalpur", *A.R* Vol. XVIII, 1833, pp. 23-46.

[14] Lieut. John Finnis, "A Summary Description of the geology of the country between Hoshungabad on the Nerbudda, and Nagpore by the direction of Baitoal",*JASB*, Vol. III, 1834, pp.71-75.

[15] Dr. J. Adam 'Memoranda on the geology of Bundelcund and Jabulpore', *JASB*, Xi(1), 1842, pp.392-411.

[16] James Hardie, "Sketch of the geology of Central India, exclusive of Malwa", *A.R.*, XVIII, 1833, pp. 27-92.

[17] P.M. Benza "Geological Sketch of the Nilgherries" *JASB*, Vol. IV, 1835, pp.413-438.

on that most interesting formation, the Deccan Trap, discovered, about 1832, fossili ferrous Interappean limestone in the Nirmal Hills, north of the Godavari, an account of which he furnished in a letter to the society.[18] Colonel Sykes had also written upon the trap formation of the Deccan.[19]

But the most interesting contribution on Peninsular India was by Captain Newbold of the Madras Native Infantry, who was subsequently appointed Assistant Resident at Karnal. His first contribution wa in 1836, when he presented to the notice of the Society spcimens of a calcaro-silicious scoria, forming a small hill about eleven miles west of Ballari.[20]. But it was in 1842, in the tenth volume of the *Journal*, that he began an admirable series of papers on the geology of southern India.[21] The other contribution were by Dr. A.M. Walker and Dr. A. Christie (1841) and Messrs

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[18] J.G. Malcomson, "Note on the Saline deposits in Hyderabad", *JASB*, Vol. II, 1833, pp.77-79; "Notes explanatory of a collection of geological specimens from the country betwen Hyderabad and Nagpore" ,*JASB*,Vol. V, 1836, pp. 96-122.

[19] Cal Sykes,"Catalogue of Mammalian observed in the Dakhan", *JASB*, Vol.I, 1832, pp. 161-167.

[20] J.T. Newbold, "Notes principally geological, from on the tract between Bellary and Bijapore", *JASB*, Vol XI, 1842, pp. 941-957.

[21] Newbold, "Notes, chiefly geological across the peninsula from Masulipatam to Goa, comprising remarks on the origin of the Regu and Laterite; occurance of Managbera veins in the latter, and on certain traces of aqueous denundiations on the surface of southern India", *JASB*, Vol. XIII, 1844, pp.984-1004. And "On the Alpine glaciers, Iceberg, Dilvial and Wave translation theories, with reference to the deposits of southern India its furrowed and striated rocks, and rock basis", *JASB*, Vol. XIV, 1845, pp.217-246.

Schlagintweit (1855-56)[22].

Dr. Falconer commenced his geological explorations among the Siwalik Hills in 1831, a year after his arrival in India. It was by him and Dr. Cautley that the famous fossil fauna of Siwalik rocks were discovered.[23] Captain Herbert had examined and reported on the Siwalik rocks when engaged on the survey,[24], but captain Webb is said to have been the first to prove the existence of fossil bones in 1831 and Cautley energetically followed up the search by blasting operations in the Kalwala pass of the Siwaliks. In 1834, Baker and Durand found the great ossiferous deposits near the valley of the markunda, below Mahun.[25] Dr. Royle, in his great work on the Himalaya, "Illustration of the Botany and other Braches of Natural History of the Himalayan Mountains", figured and described the Himalayan fossil.[26] Dr. Gerard was

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[22] Dr. A.M. Walker, "On the geology .... of Hunum Koodah (W.H. the Nizam's territory)", *JASB*, Vol. X, 1841, pp. 471-476.

[23] Of their many papers some are Capt. Cautley and Falconer, "Notes on the Ursus Sivalensis, a new fossil species from the Sivalikh Hills", *A.R* Vol. XIX, p.193. "Synopsis of Fossil Genera and Species from the Upper Deposits of the tertiary strata of the Swialikh Hills, in the collection of the authors", *JASB* Vol. IV, 1835, pp. 706.

[24] Capt J.D. Herbert "Report of the ;Minerological Survey of the Himalayan Mountain lying between the rivers Sutlej and Kalee. Illustrated by a geological Map",*JASB*, Vol. XI, (suppl), 1842, Ext.p.cl XIII.

[25] Major W.E. Baker and H.M. Durand, "Table of sub-Himalayan Fossil Genera in the Dudupur Collection", *JASB*, Vol. V, 1836, pp. 291-293 and also pages 486-504, 661-669, 739-741.

[26] Dr. J. Forbes Royle, "Illustration of the Botany and other Branches of the Natural History of the Himalyan Mountain and of the Flora of Kashmir", *JASB.*,1834, Vol. III, p.530.

the first discover of fossil shells in the Spiti Valley.[27] Rev. Everest contributed a memorandum on them in 1833, and two years later brought before the society some observations which he had made on a journey from Mussourie to Gangotri.[28]

Another field explored by geologists in India was Dynamical geology. In study of volcanoes, the earliest geological contribution to the society's 'Transactions' was a note on Barren Islands and its volcano by Lieut. R.W. Colebrooke.[29] Colonel Baird Smith, of the Bengal Engineers, was the first to record and analyse the phenomena of Indian earthquakes. The work includes a historical summary of known shocks from 1803, the study of a particular earthquake in 1842 and remarks on the points to be observed during earthquake shocks.[30]

Glaciers were studied in different regions, mostly sources of rivers like Ganga

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[27] Dr. J.G. Gerard, "Observation on the Spiti Valley and circumjacent country within the Himalyan Mountain", *A.R*,Vol. XVIII, 1833, pp.238-278.

[28] Rev. R. Everest, "Memorandum on the Fossil Shells discovered in the Himalyan Mountain", *A.R* Vol XVIII, 1833, pp.107-114. and "Geological observations made in a Journey from Musoree (mouri) and Gungotree (Gangautri)", *JASB*, Vol. IV, 1835, pp.690-694.

[29] Henry Colebrooke, "On Barren Island and its Volcano", *A.R*, Vol. IV,1795, pp. 397-400..

[30] Lieut. Baird Smith, "Memoir of Indian Earth Quakes" *JASB*, 1843 Vol.XII, pp. 257-293 and pp.1024-1056

by I.A. Hodgson, and river Gori by Captain Manson.[31] Captain Madden studied the Pindery glacier. in 1846.[32] But it was Lieut. R. Strachey who first systematically studied Himalayan glaciers. He concluded that "in the Himalayas as in the Alps, almost every valley that descends from the ranges covered with perpetual snow has at its head a true glacier".[33] Mr. Blanford, in his account of a visit to the eastern and northern frontiers of independent Sikkim, described traces of former glaciers which he had observed in the Upper Tista Valley at between 5,0000 and 6,000 feet and especially noticed the great moraines of the Lachung and Lachan Valleys.[34]

Apart from such researches there was obviously a major colonial interest around coal. The coal bearing rocks of Bengal and the Narmada valley were the first sites to be explored. Coal was known to exist in the Damodar Valley as early as 1774, and was actually worked in 1777. Mr.Jones described the coal fields and open mines in 1815

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[31] Lieut. Col.J.A. Hodgson, "Journal of a survey of Heads of the rivers, Ganges and Yamuna", *A.R.* Vol. XIV, 1822, pp.60-152 Capt. Manson's Journal of a visit to Melum and the Donta Dhoora Pass in Juwahir". Edited by J.W. Batten, *JASB*, Vol. XI, 1842, pp. 1137-1182.

[32] Major Edward Madden, "Notes on the Excursions to the Pindaree Glacier, In September 1845", *JASB*, Vol. XVI, pp. 226-266.

[33] Colonel R. Stratchey. " A Description of the Glaciers of the Pindur and Kuphilee Rivers in the Kumaon Himalaya", *JASB*, VOl. XVI, 1847, p.XVI, 794-812.

[34] W.T.Blanford, "Account of a visit to the Eastern and Northern Frontiers of Independent Sikkim; with Notes on the zoology of the Alpine and Sub-Alpine region, Parts I and II", *JASB*, Vol.XL(2), pp.367-420.

and in 1830 in the Raniganj country.[35] Mr. Hislop wrote a paper on the age of the coal strata in Western Bengal.[36] But the first published account of the Raniganj field was by J.Homfray in 1842.[37] The earliest explorer of the Narmada coal region was Colonel Ousely, who tried a quantity of the coal in 1838.[38]

Coal provides historians the picture of geology in colony. Coal was the object of commercial geology. Next to coal was iron and other minerals like laterite, manganese and gold.But an argument woven only around the question of coal and few other minerals can have serious limitations. For example it would fail to explain why the same people who worked on coal, often involved themselves in researches which could offered little commercial profit. One example on coal would be interesting. Dr. Oldham whom Kumar credits with the first systematic study of coal reserves, was responsible for the study of the great sandstone formation of Northern and central India - which he named as the 'Vindhyas'. He concluded his researches with a classification

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[35] Mr. Jones, "Descriptions of the North west Coal Districts, streteching along the coast of Damodar, from the negihbourhood of Jharia or Juria gerh to below Sanampur in the pergennah of Sheargarh, forming a line of about sixty five miles", *A.R.* ,Vol. XVIII, 1829, pp.163-170.

[36] Revd, Stephen Hislop. "On the age of the coal strata in Western Bengal and Central India", *JASB*,Vol. XXIV, 1855, pp. 347-353.

[37] J.Homfray, "A Description of the Coal Field of the Damodar Valley and the Adjacent Countries of Bearbhoom and Poorooleah, as applicable to the present data", *JASB*, 1842, Vol.XI, pp. 723-739.

[38] Lieut. Col. J.R Ousley. "Notice of the two beds of coal discovered", *JASB*, Vol. IV p. 648.

of the rock groups. He also pointed out that owing to the absence of organic remains the Vindhya could not be safely correlated to any great European formation, but they might possibly be Cambrian.[39]. This project of Oldham was actually part of a larger European interest of comparing the age of the oldest rock formations in different parts of the world. The very fact that Oldham took his own initiative for this study in India alongside his study of coal shows that conclusions about the motive of geological surveys in India cannot be simplistic. It is difficult to judge which particular interest was more important. If seen from the perspective of the colonial state the economic potentialities of these researches would obviously appear to be the only important factor. But if seen from the perspective of the scientists pursuing them, the picture might be a bit different. It might appear that along with the desire to exploit the natural wealth of the country, there were other very strong motives involved which would make the picture complicated and interesting.

Links with Europe

As I have argued earlier, the nature and contemporariness of geological researches in India and Europe tend to suggest links with philosophical developments around this discipline in Europe. A study of the attitudes and ideas of researchers in India would help to establish such links. The malign presence of colonialism was not

[39] Thomas Oldham, "Notes upon the geology of Rajmahal Hills; being the result of examinations made during the cold season of 1852-53", *JASB*, 1854, XXIII, pp. 263-283.

always colouring the data and interpretation.

Scientists and philosophers of early 19th C. Europe saw geology as a scientific discipline of the highest order; and this conception was reflected here in the colonies too. As a colonial scientist remarked in 1836, "It has been said that no man can be considered enlightened without knowing something of geology".[40]

In 1832, a short-essay appeared in the *Journal*, "Progress of European Science : Theoretical geology". This sought to elaborate to those in India the motives with which geology was pursued in Europe. After showing how scientists in Europe were trying to develop and test different theories of earth history through their surveys of rock and fossil studies, it said,

> These do not merely embrace the practical labours of the associates of the Society itself at home and abroad, in their examination of the earth's surface, the description of rocks, the order of the strata, and the classification of the fossils of every formation; but they at the same time deliver what we may consider an orthodox judgement 'excathedra' upon the various theories which the most eminent authors of the day have promulgated to the world....
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> 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 astronomer, the dynamical calculation of the mechanician, and primeaval chronology of the cosmologist and historian....[41]

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[40] "Review", *I.R*, Vol I, 1836, p. 151.

[41] "Progress of European Science : Theoretical geology", *JASB*, vol I, 1832, p. 515.

This was the particular view the scientists and philosophers in Oxford. Geology for them had the potential of changing all existing forms of knowledge and speculations about chronology and the past. The objective behind publishing such an article in *JASB* was to inspire those in India to immediate similar studies. The realization that geological theories could only be established on a global scale made it necessary for such studies to be undertaken in India too. The passage went on -

> M. Edie de Beaument, by an incredible number of well conducted observations of his own, combined with the best attested facts recorded by other observations has proved that whole mountain chains have been elevated at one geological period that great physical regions have partaken of the same movement at the same time and that these paroxysms of the elevatory force have come into action at many successive periods.
>
> We must still look for evidence where on the synchronism of the elevation of these mountain may rest to our Indian geologists, whose exertions will naturally be stimulated to attempt the solution of the problem. Russia has been before hand with us in exploring their newly acquired portions of Asia,....
>
> ....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 an 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...[42]

Before these instructions were issued, specific guidelines were published in

[42] *Ibid*, pp. 521-525.

Gleanings for those keen on geological researches. The object of such guidelines were quite similar to that mentioned earlier.

> ...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...(emphasis mine).[43]

This is followed by detailed directions for over thirty pages on collection of data for different European theories on geology. What is again interesting here is the lack of any mention of the economic aspect of geology and a concern with the 'progress of that science'. This certainly jeopardizes the assumptions on which existing literature has based its appreciation of the practice of geology in India. Another set of directions from the Geological society published in 1833 tried to draw attention towards "another aspect of geology in India - paleontology." It said,

> 1. The G.S. (Geological Society) begs to impress upon the minds of all collectors, that the chief object of their researches should be specimens of all those rocks, marks, or clays, which contain shells, plants, or any sort of petrification....
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> ...That it should be a general maxim with geological collections 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 localities are closely marked,...[44]

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[43] "Direction for the guidance of those desirious of making geological and minerological observations", *Gleanings*, Vol. II 1830, February, No. 14, pp. 41-48, 358-363.

[44] "Circular Instruction from the geological socieites for the collection of geological specimen, with a plate", *JASB*, Vol. II, 1833, pp. 557-558.

Moreover, the men who were involved in the researches in India showed close association with the ideas which were storming the philosophical world of Europe.

We have already seen how Dr. Hugh Falconer got involved in paleontological researches around the Siwaliks. In a brilliant essay, he expressed his ideas about Paleantalogy, how it would gradually lead, by joining the links of the chain one by one, to an idea of the past, an idea of what life was in those early days. He wrote around 1840, about the ;purpose of paleontology

> 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 contexts; 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 minds eye starts again into being, decked out in all the lineaments of life...[45]

Falconer expresses here the intellectual adventure involved in paleontalogical studies. This statement shows that even a geology that promised no economic returns could arouse strong passions in a scientist in the colony.

Falconer also had clear views on philosophical debates on evolution that geology had opened up in Europe between the church and the scientists. Geological researches had challenged the Christian idea of Divine. Creation, and provoked the wrath of the

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[45] Murchisons (Ed.), *op.cit.*, p. Li.

church.[46] About it Falconer wrote :

> Geology is now passing through the ordeal that Astronomy did in the days of Galileo. When the ignorant bigoted fail in reason and argument, they raise the yell of intolerance, and charge the science with infidelity,...
>
> As regards the creation of the world, the evidence is clear that millions and millions of years must elapsed between the firts appearance of life on the earth and the present day as that you and I possess eyes and ears, and have a living existence... But, remember that what I have said here bears solely upon our knowledge of the physical world, and not to the doctrines of faith for our moral and religious guidance.[47]

But similar ideas were widely expressed when someone like J. Adam a little known surveyor working in the sites of Jabalpur and Bundelkhand, wrote about the purpose of geology :

> To trace the changes on the ever-varying surface of the globe; to compare the present with the past, and 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,...[48].

When Adam, described man "the proud lord of all" to be the final form of evolutionary existence, he reflected the strong positivist premises of contemporay European geology. Buckland too argued that all evolutions was towards man, the ultimate. We can add here that Adam like many other surveyors in India was not

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[46] Gillispie, *Genesis and Geology.*, *op.cit.*

[47] Murchison, *op.cit*, pp. Lii - Liii.

[48] Dr. J. Adam. "Memoranda on the geology of Bundlchand and Jabulpur", *JASB*, vol. XI, 1842. p. 393.

formally trained in geology. So the fact that very similar ideas about geology were conceived at these various levels of scientific research shows the general attitude towards natural history at that particular time. Attitudes crossed the dividing lines between the colony and the metropolis, between those with formal training and those with amateurish interest.

Satpal Sangwan in a recent essay has illustrated that various European projects were taken up by these Scientists.[49] Rodrick Murchison's quest for extending Silurian classification into vast new territories around the world were taken up by the Indian geologists. The likes of Andrew Fleming, Richard Strachey and John McClelland took up the task of redefining, reshaping our conception of the interior and exterior of the earth. Fleming, for instance had direct reference to Murchison's interest in the paleazoic strata of the Salt range Strachey discovered Silurian fossils near the axis of the Himalayas. Sangwan goes onto show how the colonial scientists gradually started to create a niche of their own in geology and even to lessen metropolitan control in matters of routine technical and chemical analyses. His essay is an interesting study of the ambitions of these scientists and how they pressurized even the colonial government to give recognition to pure science researches. Sangwan's work stresses largely on the scientists' relationship with the metropolitan and colonial state. It, however, overlooks important questions of motivation for these scientists and the circumstances of their research. Although agreeing largely with him in the link he has

[49] Satpal Sangwan, "Re-ordering the earth: The emergence of geology as a scientific discipline in colonial India", *IESHR*, 1994, July, September, pp. 291-310.

drawn between the metropolitan and Indian researches, I would like to differ from him on the question of methodology. His essay is based mostly on private papers and letters of the scientists. These I feel give an incomplete idea of their perception and particular attitude towards their discipline. I would like to suggest that influences which shapes scientific thought cannot be ascertained without a study of the scientiifc texts. Thoughts expressed in private correspondences might not actually shape the nature of research work. Research papers, the scientific texts, often give us a different idea the committments of the scientists attitude towards their discipline. This chapter attempts to study the nature of geological research through the texts produced at the time.

The questions of motivation for their work was again largely woven around the Asiatic Society. It was the central body to inspire and instruct the members and others into various researches. By 1830s, when geological researches had become quite popular under the 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 boast in the face of the scientific world in Europe that they are worthy of a prominent place in their transactions of the physical class for proof in the papers of Voysey, Herbert, Everest, ...We publicly avow our belief that if any minerologists were to visit the society's rooms now, and view the specimens in minerology,... they would recieve of full and satisfactory proof that much has been done in this department.[50]

In a significant way the Society attempted to spread the amateurish values

[50] "Review", *op.cit* ., p. 154.

towards the practice of Science. It tried to encourage geologists to encounter hardship in their researches with the sole aim of serving the science and human spheres of knowledge, not to look for pecuniary gains or other recognitions as that might distract their attention. It also encouraged them to involve themselves even into the most minute and obscure objects of study. The editioral of *Journal* while lauding the award of gold medals to Cautley and Falconer added.

> We might expatriate upon the gold medals awarded by the London geological society to Messers. 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. (Spilbury) not to confine himself to gigantic specimens, but particularly to select from the mass of fragment, teeth of all sorts....[51](Emphasis mine)

This attempt to remind the members about the 'true commitment towards science', even against a Wollaston gold medal which was so rare for these scientists is quite remarkable. It only goes to show how strongly these men felt about these values and tried to remind others about them. One is once again reminded of Gillispie's observation about how scientists had supposed themselves to be disinterested, unassuming and absorbed in the study of nature for its sake and for the good of humanity.

However, unlike meteorology, Indian geology got recognition among scientists in general much later. The indifference of the government was always there, against

[51] Editorial Note to Dr. G. Spilbury's "Notice of new sites of fossil Deposits in the Nerbudda Valley ", *JASB*, 1837, Vol. VI, p. 489.

which the scientists often complained. This complainant against the colonial state went along with the fascination with France, expressed in comments like, "her (France's) scientific institution have attained greater perfection in India. Geological discovery than any of those in Britain."[52]. Apart from indifference to the state what also plagued such researches in the early period, till atleast 1830s was the general lack of interest towards India for geological researches, for some reason. Even other colonies under the British rule had got attention much earlier than India. The few colonial scientists doing researches in India often lamented the lack of knowledge of the physical structure of this vast land. Even as late as 1829, James Calder writing about his general observation on the geology of India, sounded rather dissatisfied with the attention India had received from English Geologists. He wrote,

> 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 quarters of the globe, she should have shown such supiness and indifference respecting the Natural History of her eastern domination. In the colonial possesstion of other nations, the whole field of nature has been explored and described by scientific and enlightened travellers; whilst in India, it has been almost entirely neglected,...[53]

He mentioned Voysey's individual efforts which were great according to him, but complained against the lack of systematic study necessary in a huge country like India. In such a situation he thought it best to be modest while drawing up plans for the

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[52] "Review" *op.cit.*, p. 152.

[53] James Calder, "General observations on the geology of India", *A.R.*, Vol. XVIII, 1829, p.1.

future of Indian goelogy and at the same time following the European model to attract attention-

> ....Our safest plan will be to confine ourselves as much as possible, within simple rules, and to such terms of nomenclature as may least embarass the subject. ... and it would seem that our adoption of the synoptical arrangements above mentioned, as far as practicable by leading to an uniformity in our pursuits, and what is still more important, to an identification of our principal Geological Strata with those of Europe, will preserve us from many errors: it will, besides prove advantageous in rendering our description more intelligible to all persons in England, who may be interested in the Geology of India.[54]

So for Calder also, with his modest plans, study of Indian physical structure had to be compared with those of Europe. Study of Indian geology was not to be restricted within the physical boundaries of this country only.

By the mid 1830s, scientific interest in Indian geology had really picked up and within a very short span it made huge progress. From this period India contributed various cases to the science of geology.

As mentioned earlier, the most important fossil discoveries in India were done in the Siwaliks. Both Falconer and Cautley made several significant contributions. In 1837, they jointly wrote about a new fossil 'Ruminant Genious', which was named "Sivatherium Giganteum" after the God 'Siva'. This they considered as a new accession

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54 *Ibid*, p.21.

to extinct zoology, the 'most remarkable of the past tenants of the globe.' It was large in size, 'surpassing the Rhinoceros'. It was a major finding according to him as it filled up the important blank space between the Ruminanta and Pachydermanta in the sequence of animal species. [55] In 1840, Capt. Cautley discovered another very interesting fossil in the Siwaliks, that of a 'Camelidae'. The discovery of this fossil in India was of extreme importance according to Cautley because no decisive proof of any of the Camelidae, either camel, dramedary, or lama, had helped to prove that the Camel lived at the same time with the Sivatherium, Anoplotherium - Simia,Hippopotamus and Rhinoceros. This fossil also established a link between Pachydermanta and Ruminanta.[56]

The fossil remains of the Hippopotumus in the Siwaliks Hills helped to recognise the character which distingushed the Siwaliks species clearly not only from the existing ones from Africa, but also from the fossil species hitherto found and discovered in Europe.[57] Among other interesting fossils found in the Siwaliks was one that closely resembled the Tiger and yet was considerably smaller in size and perfectly distinct

[55] Hugh Falconer and Capt. P.T. Cautley, "Sinatherium Gigantuim. A New Font Ruminent Genus. From the valley of the Markanda in the Siwalikh Branch of the Sub-Himalayan Mountains" , *A.R.*,Vol. XX, 1830, pp. 1-23.

[56] Cautley, " On the Fossil Remains of Camalidoe of the Siwalikhs", *JASB*, Vol.IX, 1840, pp 620-23.

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

otherwise.[58]

Falconer's discoveries were even more remarkable than those of Cautley. He was largely responsible in turning the scientific attention of the world towards Himalayas. His conclusions about the geological formation of India were very original. According to him the 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. An upheavement took place, which converted these straits into the plain of India, connecting them with the ancient continent. The Siwalik fauna then spread over the continent from the river Iravati in Burma to the mouths of Indus. After a long interval another great upheavement followed, which threw up a strip of the plains of India, formed the Siwalik hills, and increased the elevation of the Himalayas by many thousand feet. This event, and the climatal changes which it involved caused the extinction of the Tibetan and Siwalik faunas. In contrast to what had happened in Europe, there was no decrease of temparature here which is at present perhaps warmer than the tertiary period. [59]

Elsewhere, in the Narmada Valley in Central India, several significant fossil findings were made. An elephant head was found there. There was another specimen

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[58] Falconer and Cautley, "Note on the Felix Cristota, A New Fossil Tiger, from the Siwalikh Hills", *A.R.*, Vol.XIX, 1836. pp. 135-142.

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

of a slender tusk five feet and nine inches in length.[60] A bed of fossil shells were found, which was considered very interesting as they were suspected as to be marine ones.[61]

Thus in paleontology Indian scientists had already made great strides and drawn significant conclusions regarding India's physical past. So much so that Falconer, while addressing the Royal Asiatic Society of London, in 1844, claimed that through the works 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 enquires has been to show that the civilization of atleast a large section of mankind first dawned in the valley of Ganges.[62]

The contribution of India in other fields of geology was also considerable. There were important studies on the Glaciation, Diluvial Theory. This was one of the two major geological theories in the 19th Century. Introduced in Great Britain by Agassiz and Buckland, it postulated the former existence of permanent snow, ice and glaciers over a large part of the northern hemisphere. Captain Newbold carried on the

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[60] "Note on various fossil sites on the Nerbudda; illustrated by specimens and drawings", *JASB*, Vol.VIII, 1839, p.150.

[61] Miscellaneous "Discovery of a Bed of Fossils (Marine?) Shellon the Table Land of Central India," *JASB*, 1833, Vol.II, p. 376.

[62] Murchison, *op.cit.*, Vol. 1,p.1.

survey in Southern India in 1844 as a part of an attempt to apply the theory to the southern hemisphere.

Newbold in his paper discussed this theory as propounded by European scientists like Cherpentier, Venetz, M. Agassiz etc. He also provided examples of studies being carried out elsewhere like central Russia, in South America by Darwin and in north America by Prof Hitchcock. In that connection, he wrote:

> General Briggs, perceiving that India was silent, while Europe, part 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, and among others to the Marquis of Tweeddale and General Fraser, to whom I have already transmitted some memoranda on the subject, at their request.[63]

The unique feature of the geology of South India, he wrote, was the total absence of any notice of a boulder or drift formation, analogous to that which prevails to a great extent over the surface of the northern part of Europe, and in the higher latitudes of the southern hemisphere. This feature is also found, according to him in the countries nearer the equator, on the southern and eastern coast of Mediteranean, the Red Sea area, Egypt, The Southern parts of Asia minor etc. This supported the general iceberg theory that the masses of drifting ice in approaching warmer latitudes melt

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[63] 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 pp. 87-89.

from the warmth of the sea and the action of the sun's rays on their sides and surface, and discharged their rocky freight long before reaching the equator. On the other hand the existence in South India of the polished surface of rock, grooves, perched blocks, truncated conical mounds, are unquestionable evidences of the overland march of glaciers conveying boulders, grovel and loams to great distances.[64] India as a tropical country provided some important links in this general theory. Infact, Newbold urged for more evidence to be accumulated regarding the geology and former physical phases of tropical zones which would make the theory more conclusive.[65]

On the glaciers of the Himalayas, Messers. Schlagintweit found evidence that differed from Europe. They found evidence that the glaciers were at present smaller than they were at some former time. This greater extension of the Himalayon glaciers, at some former period was a phenomenon very different from that of Europe which gave rise to the 'glacier theory' by which an attempt was made to explain the former enormous extension of the Alpine glaciers, the existence of the great erratic deposits all around the Alps. In Europe the erratic blocks were in situation very different from the ancient moraines in the Himalayan glacier.[66]

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[64] *Ibid.*, p. 224.

[65] *Ibid.*, p. 217.

[66] Adolphe Schlagintweit and Robert Schlagintweit, "Report on the Progress of the Magnetic Survey of India and of the researches connected with it in the Himalayan mountains from April to October, 1853", *JASB*, Vol. X, 1856 Part I p.124

Laterite rock typical of tropical regions was first encountered by Francis Buchanan, who called it "indurated clay" and found it most valuable for buildings.[67]

J.D. Herbert in 1829 wrote a note on the occurance of gypsum in the Indo-Gangetic tract of mountains which seemed to contradict the existing theory of the location of that material. According to different leading geologists of Europe at that time, gypsum was necessarily found in the newer red or saliferous sand-stone or its associated rock - the mountain lime stone. It was with this consideration that Herbert took the valleys that stretch along the foot of the Himalayas as the most probable location of that substance. But gypsum was not found there. The clay-slate formation which bounds these valleys to the north and which certainly possessed none of the character described by geologists for gypsum deposits, contained gypsum. This led Herbert to claim that gypsum formation was not always of the primary age as generally believed. In a post-script to his article, Herbert mentioned the recent findings of M.Brochant of the gypsum in Alps, which confirmed his theory.[68] In 1832, Capt. Cautley also wrote a note on the gypsum of the Himalayas, where he argued along similar lines. He showed that the findings in the Himalayas prove that gypsum can no longer be entitled to a place either in the primary transition or secondary classes, but

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[67] Quoted by Calder, *op.cit*, pp 4-5.

[68] J.D. Herbert, "Notice on the Occurance of Coal, within the Indo-Gangetic Tract of Mountain," *A.R.*, Vol.XVI 1828, pp.397-408.

must be considered as an adventitious formation common to all ages.[69]

Captain James Franklin's surveys of diamond fields in Panna, Bundelkhand challenged the existing hypothesis that diamonds were always found at the same level above the sea. His findings showed evidences of diamonds at different levels. He also expressed his doubts about Sir James Hall's theory of the origin of diamonds - by the consolidation of strata - which he found inapplicable in these diamond mines.[70]

Rev. S. Hislop in his study of the geology of Nagpur state, came up with important propositions about the geological history of Deccan. He argued that the overlying trap of central Western India, cannot have been poured out in the bed of the ocean, but must have been erupted in a lake or chain of lakes, and consolidated in general under no greater than an aerial pressure. The Deccan exhibited no evidence of having been submerged by the ocean since a period interior to the Oolite age.[71]

Dr. Tytler, in his characteristic confident style challenged Newton's theory of

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[69] Cautley, "On the Gypsum of the Himalaya", *JASB*, Vol. I, 1832, pp. 289-296.

[70] James Franklin, "Diamond mines of Panna in Bundelkhand", *A.R.*, Vol. XVIII, 1830, pp 100-122.

[71] Rev. S. Hislop " Geology of the Nagpur State," *Journal of the Bombay Branch of the Royal Asiatic Society*, (Henceforth, *JBB*) Vol. IX, 1853-54, pp. 58-76.

'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.[72]

This was a brief sketch of the different ways scientists in India had attempted to contribute to the science of geology, and how they were working and experimenting with, as well as questioning, various European theories in these conditions. Clementz Markham writing in 1870s concluded his section on geology by paying this tribute to the geologists in India:

> ...Inspite of all difficulties of climate, inaccessibility of districts, and slowness of means of travels they have examined an area about five times as large as Britain.
>
> These important discoveries have thrown light upon the state of India in the most remote ages. On their authority we may conceive an ancient sea to have occupied the valleys of the Indus and Ganges, washing the bases of the Himalayas on one side, and the Vidhyas of the Deccan on the other,.... In course of time the sea was filled up, and alluvial valleys teemed with the animals whose fones are now imbedded in the Sawalekh. Similar remains exist in Sindh. They were also found by Mr. Crawford on the banks of the Irawadi in 1826,... These points indicate the vast area over which the Sawalekh animals of that remote tertiary age roamed.......[73]

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

[73] Markham, *op. cit.*, p. 234.

Markham who was himself associated with surveys in India obviously had a sympathetic view of the achievements of these geologists. But what about those in England? How did the geologists of England and elsewhere in Europe recieve their works?

As already mentioned, Cautley and Falconer were awarded gold medals by the London Geological Society in 1837, for their interesting findings in India. The learned societies of Europe and America hastened to mark their appreciation by the bestowal of appropriate honours. [74] Sir Charles Lyell, the then president of the Geological Society paid a deep tribute to their efforts while presenting the gold medal. He acclaimed the way they overcame their problems:

> ...but they were not versed in fossil oestology, and being stationed on the remote confines of our Indian possession, they were far distant from any living authorities or books on Comparative Anatomy to which they could refer. The manner in which they overcame these disadvantages, and the enthusiasm with which they continued for years to prosecute their researches, when thus isolated from the scientific world, are truly admirable.... From time to time they earnestly requested that Cuvier's works on oestology might be sent out to them, and expressed their disappointment when, from various accidents, these volumes failed to arrive. The delay, perhaps, was fortunate; for being thrown entirely upon their own resources, they soon found a Museum of Comparative Anatomy in the sorrounding plains, hills and jungles, where they slew the wild tigers, buffaloes, antelopes and other Indian quadrepeds, of which they preserved the skeletons, besides obtaining specimans of all reptiles which inhabited that region. They were compelled to see and think for themselves, while

[74] Bose, D.M. (ed). *op.cit.*, p. 523.

> comparing and discriminating the different recent and fossil bones and reasoning on the laws of comparative oestealogy, till at the length they were fully prepared to appreciate the lessons which they were taught by the works of Cuvier.[75]

Like Geology, other sciences in a colony too was a story of adjustments and often turning obstacles to advantages. That is how western science entered the non-westerm world. Driven by their faith in the universal basis of knowledge the scientists were prepared to overcome the particular obstacles and hardships which their research entailed. It was largely because of the manner in which they adjusted their knowledge and techniques in the various distant parts of the world and yet remained firm on the basics of their epistomology, that western science could set a footing in these places.

After this acceptance, there was a growing demand for the Siwalik fossils in Europe. The casts of some of the fossils were accepted in every great museum in Europe. Professor D. Sedgwicke of Cambridge asked for them, the Imperial Academy of Sciences at St. Petersberg and the Danish government also requested casts.[76]

Buckland was particularly interested in Siwalik fossils. His book *Reliquiee Diluviance* refers to Captain Webb's fossil collections in Himalaya. Buckland believed that the discovery of fossil monkeys in tertiary beds of the Siwalik hills would crack the foundations of the conception that humans stood at the non-fossilized apex of

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[75] Murchison, *op.cit*, p.XXX.

[76] Desmond, *op.cit.*, p. 59.

progressive change.[77]

The general awareness of towards Indian geological findings can be understood from this letter written by Dr.Tamman from Berlin to the Secretary of the Bombay Asiatic Society while sending some of his own collections. He wrote,

> ...I request you, Sir, to send me in return mineral from the East Indies, what you may think are just and equitable or equivalent. I am in the possession of one of the greatest and most beautiful collection of minerals we have in Europe, but I am exceedingly poor in the mineral production of your large and unknown land.
> ......I wish to augment my relation of exchange with your country, and I request you, Sir, if possible to communicate to the Members of your esteemed Society in the following address...[78]

These are some of the cases where recognition was given to the Indian Scientists' efforts in india. Needless to mention they remained restricted. For many geologists like life in the colony was hard. A scientist mentioned that geology as a science appeared least attractive from outside,

> The objects of geology present little to allure a general enquirer; and indeed taken singly, may be said to be least attractive that can engage the attention of the mankind. A bare rock or a clod of earth offers in itself nothing interesting....[79]

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[77] Rupke *op.cit*, p.164.

[78] "Letter from Dr. Fr. Tamman, at Berlin to D.B. Orlebar, Esq. transmitting specimens of minerals", *JBB*, Vol. I, July 1844, pp 87-89.

[79] Adam, *op.cit*, p.3.

Conclusion

And yet, the colonial geologists involved themselves in the studies of these rocks and clods of earth across the vast expanse of this land. Why? was it just because the coal fields were 'looming large'? Can that explain all these surveys with no potential for mineral wealth? There was obviously something else involved here. Nurtured within empiricist rationalism, and convinced of the universal claims of Western Science, they saw themselves engaged in the search for pure knowledge. They talked of their "the disinterested love of science", and their urge to know the physical world around them and understand the past for its own sake and for the sake of knowledge. In this sense geology in the colony was inspired by the same spirit that largely influenced study of natural sciences in colonical India.

Exploitation of natural wealth, particularly in a colony, was certainly a major concern for the state. But from the perspective of the scientific community, a colony was not always seen as a reservoir of natural resources, it was also as a field for stretching the boundaries of knowledge. Thus geology in colonial India was not always a result-oriented research as Deepak Kumar argues. It had ample scope for knowledge-oriented 'Pure' research too. It was a dependent science in the sense that much of the instructions and formulation of theories were actually done in England. The scientists followed the paradigm and boundaries of research set in Europe. But inspite of that the scientists in India had to appropriate western theories creatively, and re-interpret their discipline to understand unfamiliar landscapes when it came to day to day survey. Although remaining loyal to the larger confines of the western science they in their own fields questioned and attempted to modify the various theories from their Indian experiences.

CONCLUSION

The concept of imperialism, in both its cultural and economic dimensions cannot adequately explain the history of science in a colony. This was a history of ambitions, beliefs, frustrations and ecstasies which needed to be understood. These were feelings which were peculiar to scientific research and which scientists in the colonies shared with others working on similar projects elsewhere in the world. The scientists in India were well aware that in the long term their careers unfolded within that wider realm of science, whose standards had no necessary relevance to the colonial situation and its appointed guardians. It was only towards the late 19th C. that the state realized that its purpose could be better served if science was used as an instrument of power. The scientists on the other hand, who had never any problem about serving the government, joined hands with the government. Subsequently various government departments on separate disciplines were established and extensive training and education in western science began. It is in this late colonial period that the links with imperialism can be established more clearly. It is to be noted, however, that the scientists continued to work on projects which had little importance for the colonial state.

In my chapter on geology I have shown different contemporary European geological studies in India. There were efforts to reach general conclusions about certain natural phenomenon like earthquakes, glacial movements and continental shifts, to compare and combine their variations over different parts of the earth. A study of meteorology showed how the scientists felt that the tropical conditions of India facilitated certain types of researches.

However there is a difference in the way the concept of 'tropics' appeared in the discourses of nineteenth century meteorologists and anthropologists. For the anthropologists 'tropics' had a distinct hierarchical and racial connotation. The tropics meant 'primitiveness', racial inferiorities, and European prejudices of the 'other'. For the meteorologists 'tropics' appeared to symbolize difference without a connotation of hierarchy.

Very importantly the meteorologists tested the tropics with the same parameters and standards through which they had judged European conditions. India was judged in meteorology by the same frameworks and positivist prejudices that they were applying to Europe or any other place. This was certainly not the case with anthropology, where the particular racial and geographical prejudices gave rise to different standards and vocabularies of judging the other.

The tropical situation certainly added variation, but as I have mentioned earlier, the scientists were working within the contemporary modern scientific paradigm that set their criterion for choosing problems. The tropical climates tended to facilitate some spheres of research like the phenomenon of atmospheric pressure, the effect of moon and its subsequent effect on human health. As Balfour mentioned, such effects were also observed in Europe, only that in India the links could be seen more directly.

However, it would be far too much to suggest that the experiences of the scientists in Europe and India, working with the same methodology were exactly the same. One major problem for colonial scientists was recognition for and acceptance of their work in Europe. It is perhaps obvious that the scientists would seek to establish the legitimacy of their own work. What is interesting is the optimism and confidence with which they did it. Their assertions were also not pure rhetoric and were accompanied with detailed technical evidence and mathematical results. Also interesting is the way they adjusted to particular difficulties of working in a place far away from Europe and often turned the disadvantages into advantages.

Another sphere where their experience differed from Europe, particularly France, was state patronage. The economic motivations of the colonial state were very distinct from the European states, and thus the state did little to encourage fundamental research - the search for knowledge only for its sake. It is this contradiction which colonial scientists failed to grasp and thus dangled between their dreams and reality.

One last point remains to be made. The processes of insulation, secularisation and professionalisation of the scientific community in India was a gradual process, like Europe. The objective outlook towards nature was certainly not fully accomplished by the 1780s but the process had already begun. There were reflection of Arcadian notions of nature even among the scientists. A very interesting phenomenon is that in the early years, there was a conspicuous absence of zoological researches. The reason was largely because Jones was averse to such studies. In the tenth Anniversary Discourse of the Asiatic Society, he gave his reasons in a passage which reflected sentiments of the 'old world' natural philosopher with humane concerns about nature. The contradiction is interesting because Jones himself had indulged in botanical studies on Linnaeus' model. He said,

> Could the figure, instincts, and qualities, be ascertained either on the plan of Buffon, or on that of Linnaeus without giving *pain* to the object of our examination, few studies would afford us more solid instruction, or more exquisite delight; but I never could learn by what *right*, nor conceive with what *feeling* a naturalist can occasion the misery of an innocent bird, and leave its youngs, perhaps, to perish in a cold nest, because it has gay plumage, and has never been delineated, or deprive even a butterfly of its natural enjoyment, because it has the misfortune to be rare or beautiful.[1] (emphasis mine)

Thus till the 1820s such feelings by Jones and others tended to discourage zoological researches. By that time the processes of professionalisation, specialisation and objectification of scientific activity were more complete. The foundation of the Calcutta Medical Physical Society in 1823 and the Physical Committee within the Asiatic Society in 1828 marked two important developments in the process. These two specialised bodies gave a more secular and professional shape to ongoing scientific researches in this country. Thus in the 1830s when Cautley and Falconer established a Museum of Comparative Anatomy in the foothills of Himalayas and slew the wild

[1] *A.R.*, Vol. IV, 1807, p. XXVII.

animals from surrounding regions to keep their skeletons as specimens, we do not find sentiments similar to Jones' being expressed.

The process was almost complete in the 1870s during Blanford's time when scientists were appointed by the government itself on various projects. Whether that opened paths for state-sponsored fundamental research in a colonial India is a difficult question to answer and something that need to be studied.

However, in the choice of research agendas the scientists continued to be distanced from the state throughout the colonial period. The processes of professionalisation and specialisation of the scientific community accentuated this distance. It is for this reason perhaps that they misconstrued the basic nature of the colonial state and aspired for a status similar to that of their European colleagues. It is perhaps because of this insulation, that the scientists in the coming years, missed out on another apparent contradiction. That was between their'liberal', 'rational', scientific agenda of 'human welfare' and the coercive excesses of the colonial state to which they provided the instrumentalities of power.

BIBLIOGRAPHY

PRIMARY SOURCES

Unpublished Records : National Archives of India: New Delhi.

Memoirs of the Survey of India, 1773-1866.

Proceedings (Home Department, Public), 1760-1870.

Published Records

A. Contemporary Journals - Asiatic Society, Calcutta.

Asiatic Researches, Comprising History and Antiquities, The Arts, Sciences and Literatures of Asia, 1788-1835.

Gleanings in Science, 1829-1831.

Journal of the Asiatic Society of Bengal, 1831-1875.

India Review and Journal of Foreign Science and Arts, 1836-1843.

Journals of the Bombay Branch of the Royal Asiatic Society, 1840-1860.

B. **Contemporary Books and Manuals : Asiatic Society and National Library, Calcutta.**

Blanford, H.F., *Instructions for Meteorological Observers in Bengal, for the Use of Observers reporting to the Meteorological Office*, Calcutta, 1868.

______________,*Meteorology of India ; being the second part of the Indian Meteorologists' Vade Mecum.*, Office of the Supt. of Government Printing, 1877.

Corbyn, Fredericke, *Management and Diseases of Infants of the Climate of India, being Instructions to Mothers and Parents in Situation where medical aid is not to be obtained and guide to Medical men inexperienced in the narrower and the treatment of tropical infantile diseases.*, Calcutta, 1828.

Herman, *Results of a Scientific Mission to India and High Asia Undertaken between the year 1854-1858*, 3 Vols., London, 1859-63.

Horsburgh, James, FRS, *An India Directory or Direction for Sailing to and from the East India, China, New Holland, Cape of Good Hope, Brazil and the Interjacent Parts : Compiled Chiefly from Original Journals at the East India House, and from Observations and Remarks made during twenty two years experience of navigating in those Seas.*, 3rd Edition, London, 1826.

Markham C.R., *A Memoir of the Indian Surveys*, W.H. Allen and Co., London, (1871), 1878.

Murchison, Charles (ed.), *Paleontological Memoirs and Notes of the late Hugh Falconer. AM.MD. Vice President of the Royal Society; Foreign Secretory of the Geological Society of London; and for many years superintendent of the H.E.I. Company's Botanical Garden at Saharanpur and Calcutta, with a Biographical sketch of the Author*, London, 1868, Robert Hardwicke, Vol.I.

Piddington, Henry, F. *The Horn-book for the Law of Storms for the India 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*, London, Smith Elden, 1851.

____________________, *Conversations about Hurricanes : For the use of Plain Sailors*, Smith Elden, London, 1852,

Weld, Charles Richard, *A History of Royal Society, with Memoirs of the Presidents Compiled from authentic documents*, vol.2, London, JW Parker, 1848.

SECONDARY SOURCES

Books

Alvares, Claude, *Science, Development and Violence; The Revolt Against Modernity*, OUP, Delhi, 1992.

Bose, D.M., S.N. Sen, D.V.Subbarayappa (eds.), *A Concise History of Science in India*, New Delhi, 1971. INSA

Brockway, Lucille.H., *Science and Colonial Expansion : The Role of the British Royal Botanical Garden*, Academic Press, London, 1979.

Cardwell, DSL, *The Organisation of Science in England*, London, OUP, 1957.

Crosby, Alfred. W, *Ecological Imperialism. The Biological Expansion of Europe (900-1900)*, OUP. 1986.

Desmond, Ray, *India Office Library and Records : The Indian Museum, 1801-1879*, OUP, London, 1979.

Dijksterhius, E.J., *The Mechanization of the World Picture*, OUP, 1961.

Feyerabend, Paul, *Against Method Outline of an Anarchist Theory of Knowledge*, Verso, London, 1975.

________________,*Science in a Free Society*, Verso, London 1978.

Foucault, Michel, *The Order of Things: An Archeology of Human Sciences*, Vintage Books, 1973.

Fukuyama, Francis, *The End of History And the Last Man*, Penguin Books, 1992.

Gillispie, Charles, Coulston, *Genesis and Geology; A Study in the Variation of Scientific Thought, Natural Theology, and Social Opinion in Great Britain 1790-1850*, Harper Torch Books, New York 1959.

____________________________,*Science and Polity in France at the end of the Old Regime*, Princeton University Press, Princeton, 1980.

Headrick, D.R. *The Tools of Empire : Technology and European Imperialism in the Nineteenth Century*, Oxford, New York, 1981.

Kuhn, Thomas S. *The Copernican Revolution : Planetory Astronomy in the Development of Western Thought*, Modern Library Paperbooks, Random House, New York, (1957), 1959.

______________, *The Structure of Scientific Revolution*. The University of Chicago Press, (1962), 1970.

______________, *The Essential Tension : Selected Studies in Scientific Tradition and Change*, The University of Chicago Press, Chicago, London, 1977.

Kumar, Deepak (ed), *Science and Empire, Essays in the Indian Context 1700-1947*, Anamika Prakashan, Delhi, 1991.

Mandelssohn, K., *Science and Western Domination*, London, 1976.

Majeed, Javed, *Ungoverned Imaginings, James Mill's 'The History of British India' and Orientalism* Clarendon Press, Oxford, 1992.

Mathias, Peter (ed), *Science and Society 1600-1900*, Cambridge, 1972.

Nandy, Ashis, *The Intimate Enemy, Loss and Recovery of Self Under Colonialism*, OUP, New Delhi, 1983.

____________, *Science, Hegemony and Violence A Requim for Modernity*, OUP, 1988, New Delhi.

Rupke, Nicolaas, A., *The Great Chain of History, William Buckland and the English School of Geology*, Clarenden Press, Oxford 1983.

Said, Edward. W, *Orientalism*, RKP, London and Henely, 1978.

Sangwan, Satpal, *Science, Technology and Colonisation : An Indian Experience, 1757-1857*, Anamika Prakashan, Delhi, 1991.

Singer, C. (ed) *A Short History of Scientific Ideas to 1900,* Clarendon Press, Oxford, 1959.

Stephen, Sir Leslie and Sir Sydney Lee edited, *Dictionary of National Biography, From the Earliest Times to 1900,* OUP, 1917.

Viswanathan, Gauri, *Masks of Conquest; Literary Study and British Rule in India,* Faber and Faber, London, 1989, 1990.

Worster, Donald, *Nature's Economy, A History of Ecological Ideas*, OUP, Cambridge, 1977.

<u>Articles</u>

Alam, Anis, "Imperialism and Science", *Social Scientist*, Vol. 6, No.5, December, 1977.

Appadurai, Arjun, "Number in the Colonial Imagination", in Carol A Breckenridge and Peter Van der Veer edited *Orientalism and the Post Colonial Predicament: Perspectives on South Asia*, University of Pennsylvania Press, Philadelphia, 1993.

Basalla, G., "The Spread of Western Science", *Science*, Vol. 156, 5 May, 1967.

Becher, H.W., "Voluntary Science in Nineteenth Century Cambridge University", *British Journal of History of Science*, 19, 1986.

Dupree, A. Hunter, "Science in America - A Historian's View", in *Journal of World History*, 10, 1966-67.

Fleming, Donald, "Science in Australia, Canada, and the United States: Comparative Remarks", *Proceedings of the Xth Congress of History of Science*, Ithaca, 1962.

Heimann, Peter M, "The Scientific Revolution", in *The New Cambridge Modern History XIII, Companion Volume*, edited by Peter Burke, OUP, 1979.

Jenkins, David, "Object, Lessons and Ethnographic Displays: Museum Exhibitions and the Making of American Anthropology", in *Comparative Studies in Society and History*, Vol. 36, No.2. April, 1994.

Koyre Alexander, "Galileo and the Scientific revolution of the Seventeenth Century", in Peter Redondi and P.V. Pillai edited, *The History of Science: The French Debate*, Orient Longman, New Delhi, 1989.

_______________,"Galileo and Plato", in Peter Redondi and P.V. Pillai edited, *The History of Science: The French Debate*, Orient Longman, New Delhi, 1989.

Kuhn, Thomas S., "Reflection on my Critics", in I.Lakatos and Alan Musgrave edited, *Criticism and the Growth of Knowledge*, OUP, 1978.

Kumar, Deepak, "Pattern of Colonial Science", *Indian Journal of History of Science*, 15, 1, 1980.

___________,"Racial Discrimination and Science in Nineteenth Century India", *The Indian Economic and Social History Review*, XIX 1983.

_____________,"Science, Resources, and the Raj : A Case Study of Geological Works in the Nineteenth Century India", *Indian Historical Review*, Vol.10, 1983-84.

____________, "The Evolution of Colonial Science in India : Natural History and East India Company", in John M.Mackenzie edited, *Imperialism and the Natural World*, Manchester University Press, 1990.

Lakatos, Imre, Falsification and the Methodology of Scientific Research Programmes", in I.Lakatos and Alan Musgrave edited, *Criticism and the Growth of Knowledge*, OUP, 1978.

Larwood, HJC, "Western Science in the India before 1850", *Journal of the Royal Asiatic Society of Great Britain and Ireland*, 5, 1962.

Ludden, David, "Orientalist Empiricism : Transformation of Colonial Knowledge", in Carol A Brackenridge and Peter Van der Vear edited *Orientation and the Post Colonial Pradicament: Perspectives on South Asia*, University of Pennsylvania Press, Philadelphia, 1993.

Lurie, Edward, "An Interpretation of Science in the Nineteenth Century", *Journal of World History*, 10,1966-67.

MacLeod, Roy M., "Scientific Advice for British India : Imperial Conception and Administrative Goals", *Modern Asian Studies*, Vol. 9, No.3, 1975.

______________,"On Visiting the 'Moving Metropolis' : Reflections on the Architecture of Imperial Science", *Historial Records of Australian Science*, 5,3, Canberra, 1982.

Nandy, Ashis, "The Tradition of Technology", in *Alternatives : A Journal of World Policy*, Vol. IV, No.1, July 1978.

Porter, Roy, "The Industrial Revolution and the Rise of the Science of Geology", in *Changing Perspectives in the History of Science*, edited by M.Tech and K.M.Young, London, 1963.

Rocher, Rosane, "British Orientalism in the Eighteenth Century: The Dialectics of Knowledge and Government". in Carol A Breckenridge and Peter Van der Veer edited *Orientalism and the Post Colonial Predicament: Perspectives on South Asia*, University of Pennsylvania Press, Philadelphia, 1993.

Sangwan, Satpal, "Reordering the Earth : The Emergence of Geology as a Scientific discipline in Colonial India", *Indian Economic and Social History Review*, July-Sept., 1994.

Stafford, Robert A., "Geological Surveys, Mineral Discoveries and British Expansion, 1835-71" *Journal of the Imperial and Commonwealth History*, Vol. XII, 1 March, 1984.

Thackaray, Arnold, "Natural Knowledge in Cultural Context : The Manchester Model", *American Historical Review*, Vol. 79, No.3, 1974.

Viswanathan, Shiv, "From the Annals of the Laboratory State", in *Alternatives : Social Transformation and Humane Governance*, Vol. XII, No.1 January 1987.

Winans, Edgar, V., "The Head of the King: Museum and the Path to Resistance" in *Comparative Studies in Society and History*, Vol. 36, No.2. April 1994.