Another Reason

SCIENCE AND THE IMAGINATION OF MODERN INDIA

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CHAPTER TWO

Staging Science

> Despotism is a legitimate mode of government in dealing with barbarians, provided the end be their improvement, and the means justified by actually effecting that end.
> *John Stuart Mill*[1]

RUDYARD KIPLING'S NOVEL *Kim* (1901) opens with young Kim O'Hara "astride the gun Zam-Zammah, on her brick platform opposite the old Ajaib-Gher—the Wonder House, as the natives call the Lahore Museum."[2] The Zam-Zammah, an eighteenth-century cannon, once deployed to great effect by the Afghan ruler Ahmad Shah Durrani in his military campaigns, had lost its military use by this time, but not its symbolic value: "Who hold Zam-Zammah, that 'fire-breathing dragon,' hold the Punjab; for the great green-bronze piece is always first of the conqueror's loot." As Kim sat atop the cannon, kicking an Indian boy off it, he did so as a conqueror for, as Kipling writes, "the English held Punjab and Kim was English." But how is Kim's identity established? Kipling tells us that Kim's mother, whose racial identity remains unmarked, had been a nursemaid in a colonel's family and had died of cholera when Kim was three, leaving him in the care of his father, Kimball O'Hara. A sergeant in the Irish regiment of the British army in India, the father took to drinking, drifted into friendship with a "half-caste woman" from whom he learned the joys of smoking opium, and "died as poor whites do in India." It was from this half-caste woman who raised him that Kim discovered that he was English, as she, confusedly remembering the sergeant's prophecies in his "glorious opium hours," told Kim that everything would come out all right for him: "there will come for you a great Red Bull on a green field, and the Colonel riding on his tall horse, yes, and—'dropping into English'—nine hundred devils."

Such was the fabulous tale of Kim's origins and the indeterminate process by which an English identity came to determine him. Kipling at once avows and disavows these ambivalent and hybrid sources of identity and authority when he asserts: "Though he was burned black as any native; though he spoke the vernacular by preference, and his mother-tongue in a clipped uncertain sing-song; though he consorted on terms of perfect equality with small boys of the bazaar; Kim was white." Obvious and easy though it is to see how *Kim* asserts racial polarities, we should not lose sight of the shadowy background against which they come into view. Kim's whiteness, for example, does not stand separate from his blackness but is bleached from his "burned black" skin. So immersed is the formation of Kim's racial identity and authority in difference—whiteness formed on the borderlines of black and white, fact and fable, English and the vernacular—that liminality becomes the fertile ground for the production of a powerful colonizer/colonized hierarchy. If the colonial hierarchy draws force from the rearrangement of cultural difference into cultural opposition, it also opens itself up to the effects of its uncertain construction; the specter of ambivalence and loss provokes the assertion of racial mastery and haunts its existence.[3] White dominance does not diminish but acquires a different balance when its authority is forged from imbrication with the black. Kipling's avowal of racial polarity takes on a different meaning when he produces the white from the black; the relationship between black and white is reshuffled as he displaces their statuses as self-contained, originary identities.

It is telling that Kipling chose a museum as the opening setting for his tangled drama of imperial identity and power. By the end of the nineteenth century, the collection and display of artifacts and human specimens in museums and exhibitions had become the most visible modes of marking Western dominance of the world. Beginning with the Great Exhibition at the Crystal Palace in London in 1851, imperial nation-states in Europe and North America engaged in intense competition to flaunt their possessions, to inscribe their respective signatures on objects and humans across the globe.[4] They classified, named, mapped, and ordered non-Western peoples and things to realize their desires for domination. In this project, no less important than establishing standards of art, aesthetics, history, and identity was the staging of Western science as universal knowledge. This was all the more prominent within colonial territories, where museums and exhibitions functioned as instruments of the nineteenth-century "civilizing mission." These not only defined what constituted art, culture, and history, but also showcased scientific knowledge and instruments as technologies of governance and improvement. As Britain's largest and most important colonial possession, India felt the full force of such a project. Collecting, cataloging, classifying, and displaying objects, these institutions sought to establish the universality of their classificatory enterprise and to position science as a sign of modernity and a means of colonial rule.[5]

The identification of colonial power in the functioning of museums and exhibitions should cause no surprise; the staging of Western science in the interests of Western dominance, after all, is a recognizably familiar story. What escapes the attention of this often-told tale of Western power, however, is the distorted life of the dominant discourse. So pervasive and enduring is colonialism's triumphant self-description of its own career that we frequently fail to identify the subterfuges, paradoxes, distortions, and failures that punctuated its exercise of power. At issue here is the history of those practices that arose in the field of colonial power but also reordered its terms, that anchored and sustained British rule but also altered its conditions of existence. The failure to explore this history runs the risk of portraying colonial India as a place scorched by the power/knowledge axis, leaving nothing of its past except the remains of what either was appropriated (consumed and normalized, made appropriate) or stood resistant to the incendiary combine of modern science and colonialism. To fall prey to this view is to suggest that the exercise of colonial power produced only mastery, that British India's history is nothing but a record of submission (or opposition) to trajectories charted by this mastery.

My interest is to explore the history lodged in the discordant life of dominance, to outline the interstitial zone of images and practices that took shape as an effect of the contradictory exercise of British power. While I focus in this chapter on museums and exhibitions in British India during the late nineteenth and early twentieth centuries, the general object of my inquiry is the staging of science as a sign of colonial power/knowledge. My aim is to trace the enactment of other performances in such dramaturgy and identify colonial power's dislocations at the point of its deployment. John Stuart Mill neatly captured the founding logic of these dislocations when he proposed that despotism was a legitimate means of achieving the "improvement" of "barbarians." A deep rift fractured the exercise of colonial power. On the one hand, the British desired to teach the "natives" that Western science was universal and instruct them to apply the new order of universal knowledge to their objects and practices. On the other hand, the British were compelled to represent the universality of science in the particularity of the imperial mirror: the "civilizing mission" was the means of instituting science as a general form of knowledge. Such was the split between the subject of representation (universal science) and the process (colonial and particular) by which it was signified. With the claim for science's universality underwritten by this particular history, scientific knowledge and institutions emerged pursued by the stigma of their colonial birth. Science's functioning as a technology of colonial governance and as an ideology of improvement overshadowed its representation as a body of universal laws of nature. There is a parallel here with Kipling's dilemma. Just as colonial conditions obliged Kipling to produce white identity and authority in Kim's "burned black" skin, so they compelled the British rulers to hatch science's universality from its particular, colonial double.

To dwell in doubleness was to dislocate the polarities—scientific/unscientific, universal/particular, European/non-European, and colonizer/colonized—through which colonialism functioned. My aim is not only to trace such dislocations but also to identify the new space of power that comes into existence from

the undoing of polarities. How did the contradictory functioning of British rule produce a new arena of colonial dominance and indigenous agency? What took shape under the shadow of colonialism's double life?

The Discourse of Colonial Science: Classification and Function

To the British, India was an ideal locus for science: it provided a rich diversity that could be mined for knowledge and, as a colony, offered the possibility for an unhindered pursuit of science.[6] By the late nineteenth century, this sense of an unbounded opportunity was driving the establishment and expansion of museums and exhibitions in different regions of India.[7] Equally important in the rise of these institutions was the conviction that India needed a new form of knowledge. The matter was stated plainly in 1874:

> Local officers must be able to recognize with precision the various grains and other products of their districts, to enable them to deal with agricultural statistics in an intelligent manner. At present it is almost ludicrous to observe . . . how often the same things are called by different names, and different things by same names.[8]

To know was to name, identify, and compare—this was the frame in which the question of understanding India entered the discourse of colonial science. Museums were valuable because they provided an order of things by naming, classifying, and displaying Indian artifacts.[9] In this respect, museological practice differed from the cabinets of curiosities of the Renaissance: unlike these cabinets, museums organized objects to make them speak a language and reveal an order. From this point of view, the Oriental Museum of the Asiatic Society, founded in Calcutta in 1814, which was little more than a warehouse of rare objects, was no longer adequate by the 1850s.[10] Persuaded by the Society's argument that the existing separation of collections into detached parts robbed them of their scientific value insofar as it did not make visible "that series of links which actually exists in Nature," the government had the collections reorganized into colonial India's largest and most important museum, the Indian Museum, which opened in 1878 to the public in Calcutta.[11] The foundation of the Madras Central Museum has a similar history. Originating in a storehouse of curious objects, it was established as a museum in 1851 and began to function systematically after 1885, when Edgar Thurston was appointed as its first full-time superintendent. Thurston remained in charge until 1910 and expanded the museum greatly. He also became a major colonial ethnologist who pursued his special interest in anthropometry rather unusually: he kept his calipers and other measuring instruments handy, using them on native visitors to the museum—sometimes paying them, sometimes not.[12] A number of other significant museums were established during the second half of the nineteenth century, making them ubiquitous in urban India by the end of the century.[13]

As museums both spread and expanded their collections, the stress on natural history, on classifying, and re-presenting the order of nature, persisted;[14] geological and natural history collections were the predominant concerns of the older and larger museums from their inception. Important in this respect was the colonial conception that India was close to nature: its inhabitants lived close to the soil, it was home to numerous "tribes and races," and the state of its knowledge was chaotic—"same things are called by different names, and different things by same names"—and required persistent classification.

If colonialism amplified the importance of classification in the organization of museums, the imperial connection was visible also in the significant role given to order and naming in provincial and local exhibitions throughout India during the same period. The link between classification and colonialism had also marked the organization of objects at the Great Exhibition at the Crystal Palace in London in 1851.[15] Local exhibitions in India originated in the 1840s as part of the preparations for this event,

but acquired a momentum of their own in subsequent decades. As instruments for promoting commerce and advancing a scientific knowledge of economic resources, they brought artifacts into the colonial discourse as classified objects. The emergence of these artifacts as objects of discourse, however, entailed the authorization of colonial officials as experts responsible for collecting information from native informants.

> A *general list* of Sections was made in advance, and in every district visited, at a meeting of cultivators, called whether by the District Officer or an important zamindar [landlord]; a *special list* was prepared in accordance with the general list of agricultural articles of special value for that district. In some districts, as in Burdwan, Bankura and Murshidabad, *Kabirajes* [indigenous herbalists and healers] were also consulted. The list so made out was made over to the District officer or to the zamindar concerned, and things were collected by actual cultivators and others, and sent to the Exhibition.[16]

If one aim of colonial pedagogy was to instruct peasants by exhibiting their own products and knowledge organized and authorized by the science of classification, its other aim was to render manifest the principle of function so that it could be applied to improve production. Indeed, the organizers of the Allahabad Exhibition of 1910–11 stated that the exhibition's purpose was to instruct viewers in different methods of production and in the functioning and benefits of machines.[17] For example, on entering the Court of Engineering, one found water-lifts and irrigation pumps of Indian and European manufacture at work. To demonstrate the working and power of water-lifts, a series of small, measured fields was laid out, demonstrating the actual area of land irrigated. Across from this Court was a working dairy, exhibiting everything from cows to butter, including modern dairy machinery, the best breeds of Indian milch cattle, a dairy farm for commercial use, a modern village dairy, and an Indian dairy using indigenous implements. To the north was the Agricultural Court,

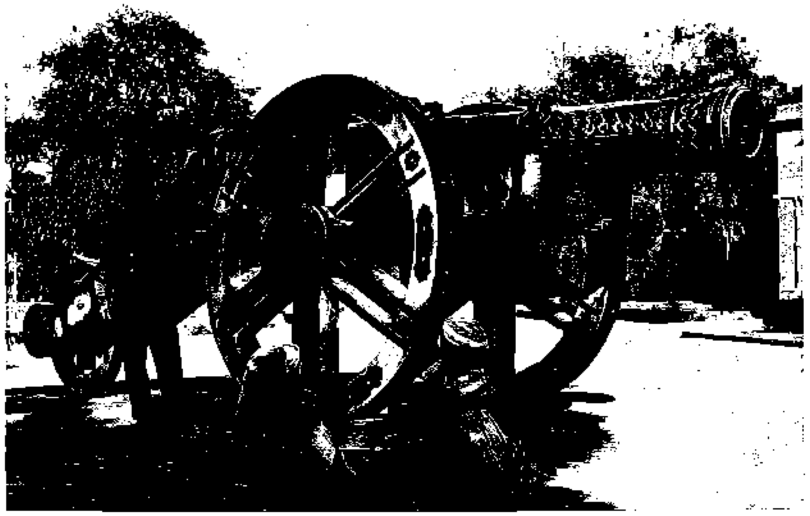

Fig. 1. "Kim's Gun": Cannon (the Zam-Zammah) outside the Lahore Museum, c. 1920s. Phot. 66/8(96). Reproduced by permission of the British Library.

where agricultural machinery from all over the world was displayed, the number of exhibits limited so as to emphasize objects in actual use. With the aim to instruct and educate, an official was placed in the Court to answer questions and put agriculturists in touch with demonstration staff and experts. The object of these arrangements was to advance popular education and commerce by demonstrating the "science of the concrete," in practical and self-evident terms.

Exhibitions did not exclude classification—the division of the space into distinct Courts meant that there was a classificatory order also at work—but they emphasized the principle of function.[18] Function as a category of knowledge grew rapidly in importance after exhibitions made their appearance in the mid nineteenth century. Agricultural exhibitions, in particular, became a regular feature of the rural landscape.[19] In Madras province, for example, agricultural exhibitions were held in every district in 1855[20] and reappeared annually for several subsequent years. Some of the agricultural exhibitions were initiated locally and

Fig. 2. "Exhibiting Science": Steam pump machinery in action at the Alipur Agricultural Exhibition, Calcutta, 1864. Phot. 1000 (4812). Reproduced by permission of the British Library.

grafted onto traditional fairs.[21] In addition to such local events, provincial and international spectacles were also staged, such as the Calcutta International Exhibition in 1883.[22] So important had these spectacles become by the end of the nineteenth century that even the Indian National Congress joined in, starting in 1901, by organizing an industrial exhibition to coincide with its annual meeting.

Organized with a great deal of pomp and show, exhibitions encapsulated the colonial staging of science as technology, as knowledge and techniques for improvement. Ordering and distributing objects to highlight function and use, they were successful in drawing a large number of visitors.[23] For example, the Nagpur Exhibition in 1865 reported 30,000 visitors over eight days; 50,000–60,000 visited the Fureedpur Exhibition in Bengal over eight days in 1873, and a million visitors went to see the 1883 Calcutta International Exhibition.[24] Museums, though sober and somber by comparison, were also successful in this respect. Between 1904 and 1914, the Indian Museum in Calcutta drew between 503,000 and 829,000 visitors annually.[25] The Madras Central Museum was equally successful, prompting Edgar Thurston to favorably compare the number of visitors to the Madras Museum to the number of visitors to the British Museum in London.[26] These numbers indicate the measure of success that colonial science had achieved in its pedagogical project. But what happened when Western science, embodied in native material, was staged before an overwhelmingly native audience?

The Liminal Man

As the colonial discourse assembled and staged India as an object of the sciences of naming and function, it also created a place for what it sought to appropriate; indigenous artifacts and "tribes and races" emerged in their native particularity as objects of scientific discourse. Forcing scientific knowledge to inhabit and emerge from the subordinated native objects, this was a process rife with ambivalence.

The liminality enacted in the performance of the colonial discourse can be seen in the "science of man" that occupied the attention of the Royal Asiatic Society of Bengal. In 1866, the Society informed its members that the curator of the Indian Museum had issued a circular soliciting the assistance of the colonial administration in the collection of human crania for the museum's ethnological section, and that his request had met with a favorable response. The Society had received some contributions from private donors, and several sources had promised further aid.[27] But the collection of skulls presented problems. One could buy skulls, as one ethnologist did when he persuaded an Andamanese widow to sell for one rupee her dead husband's skull that she had been wearing "as a sort of a locket"; but individuals could have a "not unnatural prejudice" against parting with their crania, and the "possessors of interesting skulls might not be willing to let us

examine them, while still on their shoulders."[28] An alternative, superior on both practical and scientific grounds, was suggested by Dr. Frayer, professor of surgery at the Medical College, Calcutta. In a letter to the Asiatic Society, he argued that while the display of crania was valuable, it "fell short of the advantages to be derived by anthropological science from a study of races themselves in life."[29] Thus arose the idea of assembling for display "races" found in and around Bengal and other provinces at various local exhibitions, leading up to an ethnological congress of all the races of India.

Endorsing this proposal, George Campbell, ethnologist and later governor of Bengal (1871–74), recounted being "much struck by seeing men of most interesting and curious races carrying things down to the Punjab Exhibition two or three years ago; the men, who were *not* to be exhibited, seemed to me much more curious than the things they were taking to the exhibit."[30] Persuaded by Campbell, the Asiatic Society proposed to the government that an ethnological congress be held as a "fitting adjunct to the proposed General Industrial Exhibition of 1869–70."[31] Discussions at the Society's meetings now centered on practical aspects of the proposed exhibition. Campbell thought that an "exhibition of the Aborigines would be the easiest thing in the world," and that "as they are such excellent labourers, they might be utilised as Coolies to put in order the Exhibition grounds at certain times, while at others they take their seats for the instruction of the Public." Accordingly, he proposed that

> an Ethnological branch should be added to the next Agricultural Exhibition, in which, without in any way degrading men and brethren to the position of animals, opportunity should be given for studying man at least to the same extent to which animals are studied; a study, which, in the case of humans, should extend to language and mental qualities, as well as to physical qualities. I would engage a suitable number of individuals of pronounced type, as Exhibitors on a suitable remuneration. I would erect a sufficient number of booths or stalls divided into compartments,

like the boxes in a theatre or the shops in a bazar; I would arrange, that at certain hours, on certain days, the Exhibitors, classified according to races and tribes, should sit each in his own stall, should receive and converse with the Public, and submit to be photographed, printed, taken off in casts, and otherwise reasonably, dealt with, in the interests of science.[32]

Unlike exhibits in museums, living exhibits, suitably framed in classified stalls, could talk to visitors; they could be observed in motion, as functioning objects. Insofar as such an exhibit offered an understanding of life itself, a better breeding of "man" became realizable:

I hope, I need scarcely argue, that a movement of this kind is no mere *dilettantism*. Of all sciences, the neglected study of man is now recognised as the most important. The breeding of horses is a science; the breeding of cattle is a science; I believe that the breeding of short-horns is one of the most exciting of English occupations, but the breed of man has hitherto been allowed to multiply at hap-hazard.[33]

This haphazard multiplication was evident, according to Campbell, in miscegenation. "The world is becoming more and more one great country; race meets race, black with white, the Arian with Turanian and the Negro; and questions of miscegenation or separation are very pressing."[34] By providing the means for observing and understanding separate and mixed races, living exhibits held out the possibility of envisioning a more scientific breeding of man to replace and reorder the chaos of miscegenation—such was the heady lure offered by the science of life. Given such high stakes, nothing was too much to offer at the altar of science. When asked how much clothing was to cover these exhibited "wild creatures," Campbell replied:

With respect to clothing, I would only suggest that I think we should prefer to have them in their native and characteristic shape. . . . As cleanliness comes after godliness, so I think that decency must come after science; at any rate I would only satisfy the most inevitable demands of decency.[35]

The Exhibition Committee of the Central Provinces formulated a plan to seize a family of specimens rather than individual samples of "wild tribes," and to feed and photograph their "biped specimens." An official from the Andaman Islands, in preparation for the ethnological congress, sent two Andamanese boys with new names—Joe and Tom—to Calcutta, where they sang and danced at a meeting of the Asiatic Society.[36] A great deal of ethnological inquiry was carried out by district officers in different provinces, and a sizable number of reports on "races and tribes" accumulated. But by 1868, the plan for a grand exhibition of all the races had been scaled down, and in the end, due to lack of funds, such an exhibition was held in the Central Provinces only.[37]

Notwithstanding the whittling down of overly ambitious plans, the case of the ethnological congress of races shows that the science of man was inevitably contaminated by the objects in which it inhered and the mode of its staging. How could the science of man be separated from its representation in the "aborigines" placed in theater-like stalls? The ambivalence of the colonial science of man lay in the fact that it was produced on the borderlines of black and white, of Aryan, Turanian, and Negro—indeed, on the margins between man and short-horns! Could the category of man produced by fears of miscegenation be anything but disturbed and liminal? The traces of such a category are to be found in Campbell's plea that the human exhibits be "otherwise reasonably, dealt with, in the interests of science," and the embarrassment with which he concludes that "decency must come after science." Racism, to be sure, is overwhelming in this and other colonial texts; it empowered the colonialist to place the "native" in stalls, interrogate and photograph him, and refer to him as a biped specimen. But the predicament of the colonial science of race was that it could not escape the liminality produced in its own performance. As the colonizer staged the colonized as man, he disavowed the racist polarity—the European versus the "native"—that enabled his discourse. The subordinated "aborigine" emerged as the kindred of the dominant European, the biped specimen came to stand for man.

Spectatorship: Science Taken for Wonder

The question of viewership dramatized the ambivalence of the colonial staging of science. The problem for museums and exhibitions was how to make objects rise above their concreteness and their native particularity to reveal something more abstract and universal. How was a pure order of knowledge to emerge from objects of native provenance and strike the viewer as science? This problem could not be addressed at the level of the re-presentation of objects alone; it required the conception of a viewership that was capable of separating the pure science of classification from the impurity of "same things called by different names," one that was competent to isolate the science of man from the body of biped specimens. Thus the eye became responsible for obtaining the scientific knowledge lodged in objects of India's natural history, and the production and the authority of science became dependent on visual demonstration.

The eye as the privileged means of acquiring and demonstrating scientific knowledge was particularly important for museums in India because most Indians could not read. For illiterate visitors, captions on exhibits were of little use—least of all those written in English, as were customary in museums. Given these conditions, labeling was a neglected feature of museums; labels were poorly conceived, unimaginative, and often wrong, rendering the techniques of display all the more important.[38] The standards of display were superior by comparison, enhancing the importance of visuality in museums as an instrument of education. In the absence of a reading public, the museum could substitute for a book, and the observing eye could stand for the reading eye—so thought Dr. Bhau Daji, a Western-trained doctor and a Sanskrit

scholar, who, addressing a public meeting of "Native and European inhabitants" held in 1858 to establish the Victoria Museum and Gardens, stated that

> to the unlearned especially—and in that class we must include a very great majority of our countrymen—a Museum is a book with broad pages and large print, which is *seen* at least; and by mere inspection *teaches* somewhat, even if it be not *read*.[39]

According to Dr. Daji, seeing was a poor surrogate for reading—it was not reading but inspection, capable only of "teach[ing] somewhat." But poor substitute though it may have been, the vast numbers of the "unlearned" left no alternative. Indeed, visuality became all the more critical:

> The Natives cannot understand a new thing unless it is held up before their eyes with something of a continuous perseverance. The first time they may wonder; the second time they may understand; the third time they may observe with a view to practice.[40]

The project of colonial pedagogy required the "unlearned" Indian whose education could be accomplished only by repeated visual confrontations with scientific knowledge embodied in objects. But addressing and reforming the eyes of such viewers demanded that science express itself as magic, that it dazzle superstition into understanding. Such a restaging defined the introduction of mesmerism as a science in British India during the 1840s. The chief proponent of mesmerism in India was a surgeon in the colonial medical service, Dr. James Esdaile. He was allowed to set up the Mesmeric Hospital in Calcutta as an experiment in 1846, subject to regular inspections by other medical officers to determine the scientific value of mesmerism. The inspecting medical officers concluded that Dr. Esdaile's claims on behalf of mesmeric science were untenable, but they noted that the hospital was popular with the "natives" of Bengal because of the existence of "superstition in its widest sense and in its most absurd forms." Those who had "the most implicit faith in witchcraft, magic, the power of spirits and demons, and the efficacy of charms and incantations" believed that Dr. Esdaile had supernatural powers, and the officers reported that "the common name under which the Mesmeric Hospital is known among the lower classes is that of *house of magic*, or *jadoo hospital*."[41] But how did Dr. Esdaile's hospital acquire its name as a house of magic? And why did the "natives" believe that mesmerism was magic? Is it possibly because Dr. Esdaile himself used the term *belatee Muntur*, "the European charm," to explain mesmerism to his Indian medical assistants?[42]

Magic also marked mesmerism's public staging, which was performed to establish its status as science. These public demonstrations were crucial, as Dr. Esdaile acknowledged, if mesmerism was to press its claim as a science before both Europeans and Indians.[43] At first he was skeptical of the utility of "public exhibitions for effecting a general conversion to the truth of Mesmerism" and believed that "performers in public are not unnaturally suspected to take insurances from Art, in the event of Nature failing them." In spite of his "natural distrust of public displays," however, he consented when senior officials pressured him to stage a demonstration. The performance, held before Europeans and Indians on 29 July 1845, was reported in the newspapers the next day: "The party was very numerous, two steamers having brought the curious from Barrackpore and Calcutta; and there was a large assemblage of the European and Native residents of Hoogly and Chinsurah."[44] Before the day ended, Esdaile had impressed the viewers with his many feats: Two women who were mesmerized separately in different rooms displayed identical symptoms of twinkling eyelids and swaying side to side while entranced. Mesmeric trance at long range was demonstrated on a man who, in his insensible state, evident in his cataleptic limbs, obeyed Esdaile's instructions, singing "Ye Mariners of England," "God Save the King," and "Hey Diddle Diddle." "Sleeping water" was administered—after clergymen and doctors had observed Esdaile "charming" the water—to men who turned cataleptic or became somnambulists after drinking it. Undoubtedly, the European account from which these examples are taken treated the whole spectacle as an amusing magic show, but it also

presented the show as a demonstration of the scientificity of mesmerism. Indeed it was in the public display of its magical effect that mesmerism emerged as science, perched precariously between cold scientific inquiry and "superstition in its widest sense and . . . most absurd forms."

If performance mixed science with magical spectacle, it also enhanced the importance of visuality. Museums confronted observers with an orderly organization of fossils, rocks, minerals, bones, vegetation, coins, sculptures, and manuscripts. Exhibitions, on the other hand, offered a feast to the Indian eye. Depending on the scale, no effort was spared to produce an attractive spectacle: ceremonial arches, palatial structures, military bands, lakes, fountains bathed in colored lights, food stalls, wrestling competitions, pony races, and regional theater—all combined to impress the public eye and draw it to agricultural products, manufactured goods, machines, scientific inventions, and new methods of working and living. Dramatic display was so central to the success of exhibitions that when it fell short, public commentary was sharp. This occurred when the Calcutta International Exhibition of 1883 opened after an evening of pouring rain—a damp beginning compounded by the opening ceremony being plunged into darkness when "owing to the wickedness of some wretch the electric wire was cut."[45] *The Englishman*, a newspaper always enthusiastic about colonial projects, could not refrain from commenting that the scene was "very sad, the great ceremony was torn to ribbons, the superb ruby velvet canopy was dripping like a drill cloth . . . Every Court leaked more or less—Victoria a good deal."[46] By contrast, the opening of the Allahabad Exhibition of 1910–11 drew ecstatic public praise. *Saraswati*, a premier Hindi literary journal, was moved to describe the layout and exhibits picturesquely, declaring the event a spectacular success.[47] The *Pioneer*, an English daily, gushed that "sons and daughters of the East and West" greeted the opening of the exhibition with cries of "Kolossal!, Kya ajib [how amazing]! Bāpre bāp [oh my God]! Wah [splendid], this beats Chicago! [referring to the Chicago World's Fair of 1893]"[48]

What began as representations of science staged to conquer ignorance and superstition became enmeshed in the very effects that were targeted for elimination. We encounter this intermixture in the museum's evocation of awe in its visitors, in the exhibition's utilization of a sense of marvel, in mesmeric science's attempt to show magical efficacy, and in the miraculous powers evoked by public demonstrations of scientific instruments. In these stagings of science, the cold scrutiny of scientific knowledge confronted the magic of spectacles as part of its own process of signification, as difference within itself. Within this structure of difference, science aroused curiosity and wonder, not superstition: the "Wonder House" was not the museum's polar opposite but an interstitial space that accommodated a half-awake state of comprehension and incomprehension. In the cries of "Kya Ajib!" and "Wah!" we confront not blind faith but the wondrous curiosity of "this beats Chicago" that science's authorization in magic had brought about.

Second Sight

As colonial conditions turned the staging of science into a wondrous spectacle, a space opened for the subjectivity and agency of the Western-educated indigenous elite. Trained in Western schools and colleges, and employed in colonial bureaucracy and modern professions, this elite acquired a visible presence in principal Indian cities and towns by the late nineteenth century. In a sense, their emergence was attributable to the colonial project of re-forming Indian subjects. The exhibitionary institutions contributed to this process by acting as pedagogical instruments, by inviting Indians to identify and learn universal principles of classification and function in objects encased in colonial power and exhibited as spectacle. The elite emerged from their encounter with exhibits claiming that the experience had reoriented their vision, or endowed them with "second sight." It is significant that this second sight appeared on the cusp between the exhibition of

the imperial power to name and order artifacts and the representation of this display as the spectacle of science. Placed between the two, the power of understanding signified by second sight was rooted in curiosity and wonder. Signifying neither a superstitious eye nor a scientific gaze, it was a vision re-formed by its encounter with science's representation as wondrous and useful Western knowledge. Equipped with such a vision, Western-educated Indians surfaced as modern subjects who could claim to represent and act upon the subaltern masses from whom they distinguished themselves.

The emergence of the curious eye of second sight is observable in R. B. Sanyal's *Hours with Nature* (1896), which includes a chapter titled "Round the Indian Museum," a fictional account of a visit by schoolteachers to the Indian Museum.[49] Mr. W. (West?), inspector of schools in Bengal, instructs Pandit Vidyabhushan, a Sanskrit grammarian, in a dialogue that opens with the teachers expressing amazement at the sight of zoological specimens.

> 'What a variety of forms!'
>
> 'From all parts of the world!'
>
> 'The vastness of the collection is perfectly bewildering!'
>
> 'Not so much as those strange weed-like things,' said Vidyabhushan, pointing towards some really very plant-like objects kept in cases against the Western wall of the hall. . . . Mr. W. who was attentively listening to the conversation and had noticed Vidyabhushan's embarrassment, explained that though weed-like in appearance they were in reality *animals*.
>
> 'Truth *is*, as they say, stranger than fiction,' exclaimed Vidyabhushan.
>
> 'Let us hear something about these strange forms,' cried many almost in chorus.
>
> 'Well then,' resumed Mr. W. 'those weed-like objects are "Zoophytes or Plant-animals," so called owing to their superficial resemblance to plants.[50]

The text continues in this manner for several pages, bewilderment and amazement followed by explanation and understanding. The method of comparison and classification is demonstrated, leading to the following:

> 'I have been connected,' said Vidyabhushan, 'in one capacity or another with the education of children and young men for the last thirty years, and have read and taught a great many things about animals and their ways as related in story and reading books. I know, as every school-boy knows, that lions and tigers are formidable animals; that ostriches are very large birds that live in the deserts of Africa, and are remarkable for their speed; that elephants are very sensible and amusing to children, and have their uses. But then, this is learning things without method, and is, therefore, of no value. I am so glad that Mr. W. has hit upon this plan of teaching the teachers to value system. In fact, he has given us a *second sight* [emphasis mine]. When I first entered this great hall, I was perfectly bewildered at the vastness of the collection, and had not the least idea in what order and plan they were arranged. I have got at least some notion now of their arrangement, thanks to the interesting demonstrations of Mr. W.'[51]

After describing several other occasions of puzzlement followed by Mr. W.'s explanations, the text concludes with Mr. W. stating that understanding nature requires the simplicity and the purity of a child's heart, and "an ear of faith." This statement rejects colonial power's self-identification with universality and scales down its knowledge to a set of particularly Western values and attitudes. Vidyabhushan acknowledges the importance of these values but adds that "according to our old Hindu idea 'Reverence' is another essential quality for the training of the mind." With this invocation of a "Hindu idea," Vidyabhushan does not dilute difference but affirms it as the basis for negotiating a relationship with Mr. W.'s emphasis on "an ear of faith."

As the text sketches and negotiates the relationship of wonder with science and the relationship of childlike simplicity and the Hindu idea of reverence with a Western value system, it outlines a space for an educated elite, now possessed of second sight and able to absorb Western knowledge. Second sight emerges out of

the bewilderment experienced when confronted with alien knowledge while encountering the objects in the museum. The emergence of this amazement and wonder is attributed to the performative process, not to prior scientific training—the museum-goers are "school-masters and Pandits," and the principal character, Vidyabhushan, is a scholar of grammar.[52] As a grammarian, he presumably brought logic and classification to his understanding of the museum, but this was not the same as the value system taught by the museum. Significantly, the Hindu idea of reverence invoked by the text, though part of Vidyabhushan's heritage, surfaces in the process of viewing objects in the museum. Outlined here is the notion of a Hindu conceptual system, or "Hindu science," that is not derived from or opposed to Western science. It arises as a different form of knowledge—divergent and autonomous from Western science, but not its polar opposite.

The text identifies the emergence of second sight in a museum, and historical records indeed suggest that museums took their educational function seriously. Almost all museums organized visits of groups of students and teachers to their galleries;[53] in addition many museums organized regular public lectures. In this regard, the Lahore Central Museum stands as a representative example.[54] Besides housing the Science Institute and allowing the Society for Promoting Scientific Knowledge to use its lecture hall, the museum also instituted a series of "Magic Lantern Lectures" in 1892–93 when John Lockwood Kipling, Rudyard's father, reported the purchase of a magic lantern and its apparently hugely successful use in a lecture. The topics of these lectures, delivered in both English and Urdu and by both Englishmen and Indians, varied, ranging from history to science. The best-attended lectures were apparently the "Zenana Lectures," reserved for purdah-clad women and delivered frequently in the 1910s and 1920s by Monorama Bose, a Bengali Christian woman who taught at the Victoria School, eventually becoming its headmistress.[55] She belonged to a family devoted to missionary work. Her father had converted to Christianity after graduating from the

Calcutta Medical College and joining the medical service in the Punjab, where he met American missionaries in Ludhiana. Monorama, one of his four daughters, was sent to London in 1884 to train as a teacher. While there she began to keep a diary in which she recorded her visits to Kew Gardens, the Natural History Museum, the Crystal Palace, and to a demonstration of the magic lantern.[56] On her return to India in 1886, she learned Urdu, Persian, and Bengali, joined the Victoria School as a teacher, and lectured frequently in the series at the Lahore Museum. Her lectures were not on science but on such general topics as travel and the education of women. The museum appears to have included these subjects in order to enlarge the appeal of its series of lectures.[57]

Finding and including activities with a wider appeal was a continuing feature of museums and exhibitions, and it provided the means for marking and separating the elite from the subaltern. We notice this process of marking emerging in Dr. Bhau Daji's conception of the museum as a "book with broad pages and large print" that taught through mere seeing the "very great majority of our countrymen"—"the unlearned." We catch a glimpse of it again in the response of Bhoobun Mohun Raha and Jadub Chandra Goswami, the two Joint-Secretaries of the Fureedpur Agricultural Exhibition, to criticisms of amusements in the exhibition: "If bands of music and other attraction are found necessary in England, how much more so is something of this sort necessary in this country."[58] That this referred not to Indians as a whole but specifically to the lower orders becomes clear when Raha and Goswami state that the performances of *jatra* (Bengali traditional theater) and nautches (dances) during the 1873 exhibition were organized "chiefly for the amusement of the lower classes, who have still a great taste for these things." The lower classes were not only marked by their taste for *jatras* and nautches but were also defined by their poor understanding of scientific agriculture. Thus these amusements were considered justified for the sake of "the improvement of the agriculturists of this

Sub-division, who were so much in need of instructions and practical demonstration on scientific mode of cultivation and manuring."[59]

Awareness of the subaltern's need for scientific instruction runs through the writings of the educated elite. It appears, for example, in an article on the Alaska-Yukon-Pacific Exhibition of 1910, published in *Saraswati*. The author, impressed by the Agricultural Court and describing the demonstration of scientific methods of production, writes of his conversation with a friend:

> 'Doesn't the sight of these things teach a great deal?' Munshiram said in amazement.
>
> 'Undoubtedly, why not? This knowledge is relevant to farmers. They have gained much by coming into this building.'
>
> 'And then there is our country, where people are living in darkness. The same old ploughs and bullocks. These unfortunate souls believe that fate determines the poor productivity of their soil. They do not realize that their miserable condition is due to their own ignorance. The same land can grow a hundred times more if scientific methods were to be employed.'
>
> 'But who will teach them?'
>
> 'Our government should spend crores of rupees to teach peasants, just as governments here do.'
>
> I smiled. Munshiram understood the meaning of my smile. He took a deep breath and joined me as we came out of the building.[60]

The admiration for scientific agriculture, the bitter recognition of the Indian peasant's ignorance, and the smile and the deep breath—these were the gestures and expressions of the discourse in which the elite formed their identity, colonized like the subaltern but unlike them, enlightened. This identity can be seen coming to the fore even earlier, in reactions to the 1883 International Exhibition in Calcutta. The *Bengalee* welcomed the idea of an exhibition, acknowledging that it could be instructive, particularly when held on a small scale in districts, but observed that a grand one such as the Calcutta exhibition ignored the character of the people it was aimed at and the resources they possessed:

> If an Exhibition were held among the remote barbarians of the Sandwich Islands, the spectacle would create astonishment, the projector would probably be worshipped as a god—an honour that would perhaps be extended to some of his commodities—but nothing solid or substantial would follow. These barbarians have no capital, and even if their curiosity were deeply stirred, and their inclinations moved, there would be wanting the capital to manufacture.[61]

A similar problem existed in India. Here, too, "artisans and agriculturists will come from the moffasil to see the great Bazar," and though they would be moved by things they saw, nothing could come of it, as they were deeply in debt and had no capital. Once again, this commentary registers the educated elite's effort to distinguish itself from artisans and peasants, who were seen as similar to "the remote barbarians of the Sandwich Islands" and whose welfare and reform they claimed as their responsibility. Eighteen years after this commentary, in 1901, when the Indian National Congress began to hold industrial exhibitions to coincide with its annual meetings, this elite emerged, organized in a powerful institution, as a class apart from the subaltern masses and determined to change them.

Science and the Subaltern

If museums and exhibitions made a space for the emergence of the educated elite from which they could act and speak, what of the subalterns? They did not write books or letters to editors. They were spoken to and spoken for. We encounter them in the discourse of the colonizers and Indian elite as icons of the ignorance and darkness both wished to remove. But this was an im-

possible goal, for the colonial project hinged on the presumed and permanent existence of the superstitious as a subaltern object to be transformed by modern reason; the ignorant and irrational could never be fully understood or completely appropriated, for that would end the "civilizing mission." Thus, if the subaltern was silenced or made to speak only through superstition, the subaltern was also assured an intractable presence in the discourse of colonial science. At once completely known (stubbornly irrational) and entirely unknowable (who can understand the ways of unreason?), the figure of the subaltern occupies a disturbing presence in dominant discourses; it represents the limit of those discourses, a marginal position against which they defined themselves.

What did it mean to identify the self under the pressure of this unknowable, subaltern other? Let us turn to George Campbell's rueful acknowledgment of the subaltern as that ineluctable difference in which colonial knowledge sought its identification.

> I often stop and look at them ["tribes and races"], and I have tried to make something of them, but they don't understand me; I don't understand them; and they don't seem to realise the interest of ethnological inquiries, so I have not progressed much.[62]

As Campbell regretfully notes the unbridgeable gap between the colonizers and "tribes and races," he also makes clear that the progress of ethnological inquiries hinged on closing this gulf. This was an impossible project, not only because the discourse required the unassimilable subaltern, but also because the spectacle of science could not shake off its imperial connection. To subalterns, the staging of science appeared either as an expression of the government's intent, which was always suspect, or as Western novelty. Museums and exhibitions, therefore, were read as curious, miraculous shows and often generated rumors.

By perpetuating the destabilizing momentum of rumors, the intractable subaltern became a threat. The British were thrown into a panic when, wishing to dazzle peasants into improvement and progress with agricultural exhibitions, they were met with rumors sweeping the countryside. In some Madras districts it was said that the British were plotting a new tax scheme: it was reported that while the landed gentry and traders cooperated in organizing exhibitions, others, due to their "unconquerable feelings," had "strange notions" that the government wanted to identify the best agricultural land and produce so that it could assess higher taxes.[63] Even more disturbing was the word going around the South Indian countryside during the 1850s that agricultural exhibitions were British plots to convert Hindus to Christianity:

> Superstition also lent its aid to fill the cup to the brim, and the most wild and laughably fanciful notions, were in some instances, I am inclined to think, designedly spread and seized by the people, one of which was so original that it deserves mention, *viz.*, that one of the great ends of the Exhibition was to convert the heathen to Christianity, that for this reason prizes were offered by the Government for the best paddy, that the *whole* in the District might be brought up and the natives compelled to eat boiled rice and become Christians, and that to celebrate the event, prizes were offered by Government for the best beef in the shape of cattle of all sorts, on which the Europeans were to regale at Christmas in token of thanks giving.[64]

We can read the strategy of normalization in references to superstition and "laughably fanciful notions." But this very strategy of showing the far-fetched nature of stories also opened a place for the subaltern's agency—rumors "designedly spread and seized." This contradictory process of both acknowledging and denying the subaltern a place in discourse can be observed in Edgar Thurston's description of his ethnological tours:

> The Paraiyan women of Wynaad, when I appeared in their midst, ran away, believing that I was going to have the finest specimens among them stuffed for the museum. Oh, that this were possible! The difficult problem of obtaining models from living subjects would be disposed of. The Muppas of Malabar mistook me for a recruiting sergeant, bent on enlisting the strongest of them to fight against the Moplahs. An Irula of the Nilgiris, who was 'wanted' for some ancient offence relating to a forest elephant, refused to be measured on the plea that the height-measuring standard was the gallows. A mischievous rumour found credence among the Irulas that I had in my train a wizard Kurumba, who would bewitch their women and compel me to abduct them. The Malaialis of Shevaroys got it into their heads that I was about to annex their lands on behalf of the Crown, and transport them to the penal settlement in the Andaman islands.[65]

While the wry humor of "Oh, that this were possible" and the amused description in Thurston's prose present rumors as wild stories of wild people, his retelling of these stories—indeed, the general tendency of colonial officials to retail what they regarded as fanciful—is significant. The very strategy of defining and appropriating the other in rumors compelled the colonial officials to give life to rumors, to make a place for absurd tales. In accommodating them, the colonizers opened their discourse to the wild contagion of indeterminacy characteristic of rumors, to the menace of their shadowy origins, and to their reckless reverberations once they were set in motion. Registering the threat posed by such escalating indeterminacy, one official wrote that "the most absurd reports were in circulation, no one pretending to know or [*sic*] with whom [these rumors were] originating, still they were greedily credited, and the more grossly absurd the report, the more certain was it of belief."[66] The panic felt was real enough. The exhibition in Cuddapah opened with considerable apprehension because the British were unable to read people's intentions. On the one hand, they expected considerable apathy, prompting them to consider postponing the opening of the exhibition. On the other hand, since defiance was "also stated to be the intention of those inimical to the Exhibition, all thoughts therefore of postponement were abandoned." Thus, the authorities opened the exhibition on 26 May 1856. And in fact, in the event, it was noted, "nothing was forthcoming save a few cattle."[67]

Anticipating a similar outbreak of rumors due to the impending census operations, Abdul Luteef Khan, a Western-educated Bengali Muslim, recalled the atmosphere created by rumors at the time of the Alipore Agricultural Exhibition in 1864. Among many "absurd and ridiculous stories" was one that the real reason why cattle and horses were required by the exhibition was the outbreak of a war somewhere, for which the cattle and horses would be slaughtered for food or used to transport military stores. These rumors prompted Khan to launch a campaign of education. He issued a pamphlet in Urdu which, along with its Bengali translation, was widely distributed by the government. As a result, he wishfully concluded, the "bugbear called into existence by popular ignorance has vanished, and that which was once dreaded is now invited and welcomed."[68] It is true that later exhibitions did not record similar outbreaks of rumors, but the subaltern continued to occupy an unmanageable position in colonial and Indian elite conceptions. If the lower classes did not threaten the project of disseminating science by spreading rumors, they undermined its gravity by demanding frivolous amusements as the price of their participation.

The subaltern's "inappropriate" attitude also compromised the functioning of museums. Colonial officials feared that the popularity of museums with the lower classes had driven out the elite: "The Indian aristocracy look on a museum as something pleasing to the vulgar with which they are not concerned." Frequented by the lower classes the museum in India could not be "an institution of education and research," and the intended purpose of the museum seemed threatened. In Lahore, for example, a visit to the museum was a regular feature of lower-class wedding ceremonies.[69] In Madras, as in other places, days of the most important Hindu festivals drew the largest numbers of visitors. But, contrary to what we may suppose, these visitors did not go to museums to pay obeisance to the statues of deities housed there; at least no such mention is made in any document. Instead, Hindu festivals appear to have only provided an occasion for fes-

tive recreation, which might include a visit to the museum. Describing the day of the feast of Pongal, 15 January 1895, when 36,500 visitors flocked to the Madras Museum, Edgar Thurston wrote:

> The museum grounds presented the appearance of a fair, occupied as they were by a swarm of natives in gay holiday attire, vendors of sweetmeats, fruit, toys and ballads, jugglers, mendicants and others.[70]

Describing what visitors did inside the museum, Thurston does not mention any religious purpose:

> For the great mass of visitors to the museums in India, who come under the heading of sight-seers, and who regard museums as *tamāsha* [show] houses, it matters but little what exhibits are displayed, or how they are displayed, provided only that they are attractive. I am myself repeatedly amused by seeing visitors to the Madras museum pass hurriedly and silently through arranged galleries, and linger long and noisily over a heterogenous collection of native figures, toys, painted models of fruit, &c.[71]

Thurston adds that for these uneducated visitors, who called the museum a "stuffing college" and a *jadu ghar* (magic or wonder house), the main delight offered by the museum was "in the recognition of familiar objects, which they shriek out by name, *e.g.*, kākā (the crow), pachi pāmbu (the green tree-snake), āni (the elephant), periya min (big fish—the whale!), etc."[72] When Thurston pulled out his anthropometrical instruments every evening, a crowd would gather to watch him:

> Quite recently, when I was engaged in an enquiry into the Eurasian half-breed community, the booking for places was almost as keen as on the occasion of a first night at the Lyceum, and the sepoys of a native infantry regiment quartered in Madras, entered heartily into the spirit of what they called the 'Mujeum gymnashtik shparts' [Museum Gymnastics Sports] cheering the possessor of

the biggest hand-grip, and chaffing those who came to grief over the spirometer.[73]

The Signification of Science: An Enigmatic Articulation

The history of museums and exhibitions is inseparable from their functioning as signs of Western power. This holds true not only for the colonies, but also for the West. In the West too, these institutions named, classified, and displayed non-Western objects and peoples to showcase the power and knowledge of Western nations and to reform and discipline the working classes, who were often compared with the exhibited "savages" elsewhere.[74] But it was one thing to compare class and race, quite another to conflate them in placing "natives" for display in theater-like stalls. Colonies, after all, provided the infamous "elbow room" for experimentation unavailable in Europe. For this reason, museums and exhibitions in British India remained singularly concerned with science and natural history. This also meant, however, that it was precisely in the virgin, colonial space of India that museums and exhibitions as European institutions were forced to confront their intimacy with the "native." There, the colonial "supplement," to use Derrida's term,[75] enacted Europe's authority and identity, and emerged powerfully and disturbingly. As the British staged Western science in Indian material, as they signified universal knowledge with particular, colonial methods, the native supplement, hidden in Europe, made a forceful entry in colonial discourse.

It is tempting to see the "Mujeum gymnashtik shparts" as the price European science had to pay for its implantation in non-European soil. Indeed, this perspective frames Thurston's narrative, implying that European discourses, originary and normal in the metropolis, were perverted in the process of their tropicalization in the colonies.[76] Such a view overlooks the crucial fact that the representation of Europe's originality hinged on the "native"

double. It also elides the scandalous history of the fashioning of Western knowledge's identity, initially in the foreign and exotic material accumulated in the cabinets of curiosities and later in the burgeoning colonial spoils displayed by metropolitan museums and exhibitions.[77] My point here is neither that there was no difference between Europe and India, nor that the two were locked in an implacable dialectic, now to be reversed in favor of the repressed other to explain Europe's originality. Instead, what I wish to highlight is the historical undoing of the self/other binarism, the unraveling of the narrative which posits that Western knowledge, fully formed in the center, was tropicalized as it was diffused in the periphery.[78] The paradox of the "civilizing mission" was that it was forced to undo the very opposition upon which it was founded. To achieve improvement through despotism, as John Stuart Mill proposed so baldly, was a Faustian bargain, the effects of which bedeviled colonialism; it dislodged the very civilized/savage opposition upon which colonial power depended. As the British used barbarism to deal with the "barbarians," as they also used science to mark the "burned black" Indian skin with white authority, they also undercut the very ideals of civilization and progress that legitimized their power. Such was the compulsion of empire: colonial dominance in British India had to operate through the undoing of its founding oppositions.

It was at the point of colonialism's unresolvable dilemma that an ambivalent zone of power and agency took shape. In this zone the universality of Western power and knowledge appeared in the mirror of magic and spectacle, and the sciences of classification and function instituted themselves in curiosity and wonder. From this arose the agency of the Western-educated elite, located in their "second sight" and expressed in their portrayal of science as a marvelous value system and useful technology that could be combined and enriched with indigenous traditions. Science's uncertain and other life can be also identified in the mixture of amusement and fear with which subaltern groups viewed the exhibition of artifacts, reading it as a collection of pleasing novelties and as a sign of malevolent designs upon their lives. If the British regarded both elite and subaltern responses as less than appropriate, as proofs of the dictum that natives will always be natives, they could not ignore these altogether. Seeking from Indians the recognition of Western knowledge's authority but unwilling to acknowledge them as knowing subjects, the British had to regard Indians as always less than adequate, always lacking some key attribute. This justified colonial dominance, but it also conceded that the colonial project would never achieve complete success, that Indians would remain unconquerable in the last instance. It was precisely at the site of colonialism's necessary failure to resolve its paradoxes and prevent its knowledge from "going native" that the career of science charted another course in British India.

CHAPTER THREE

Translation and Power

> . . . all translation is only a somewhat provisional way of coming to terms with the foreignness of languages.
> *Walter Benjamin*[1]

In 1896, a Calcutta journal published a poem entitled "The Blessings of Science," registering science's cultural power in the discourses of the Western-educated elite:

> Science! Thou mysterious Being! Through Thy aid we can know all:
> Man and Nature's mighty laws and what are hid in the Future's path.
> Through thy mighty aid we mortals filch the lightning from the clouds;
> Through thy aid immortalize our mortal voices low or loud,
> Through thy aid from hence I know what is made the lum'nous sun.
> By thy magic wand when 'tis touched light divides in seven hue:
> Red and violet, green and orange, yellow, indigo and blue.
> Through thy aid our fleeting shadows are imprisoned in the frame,
> Thus thou giv'st to "airy nothings" "habitation and a name."
> Through thy aid our optic powers are increased to such a height,
> Each of us, as it were, gifted with a second sight.[2]

Science's authority inhabits and animates the poem; its cultural force emerges as it brings the hidden out in the open, as it renames "airy nothings," as it redirects "our optic powers" to act as "second sight." Functioning as an aid for repositioning and reclaiming an already-present indigenous rationality, science surfaces and is itself reconstituted in the realignments of objects it achieves and authorizes. The dynamic at work in the poem invites us to view the institution of science's authority as a process of

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CHAPTER 2

SCIENCE UNDER THE COMPANY

The English East India Company was as old as modern science itself. Founded in 1600, the Company shared its early years with the Scientific Revolution, and by 1662, when the Royal Society of London was founded, was already a flourishing concern with trading bases at Surat, Madras and Masulipatam. The sciences prominent in early colonial India – botany, geology, to a lesser extent zoology – were still at a formative stage when the Company embarked on its career of territorial expansionism in the mid-eighteenth century. The first volume of Buffon's *Histoire naturelle* appeared in 1749, as Anglo-French rivalry in the Carnatic was reaching its peak; Linnaeus's *Species plantarum*, which established the binomial system of nomenclature, was published in 1753, four years before the battle of Plassey opened the floodgates to British ascendancy in Bengal. By the time the Geological Society of London, model for a new generation of metropolitan scientific societies, was founded in 1807, British power had been extended over vast tracts of northern and peninsular India and was poised for the final defeat of the Marathas. The publication in 1830 of the first volume of Lyell's *Principles of Geology*, one of the foundational texts of modern geology, came three years before the Company lost its vestigial trading rights; and Darwin's *Origin of Species* was published in November 1859, twelve months after the East India Company had finally been declared extinct.

Thus Company rule in India was contemporaneous with one of the most momentous phases of modern science, from the rise of Enlightenment natural history to the eve of Darwinian biology. The Company was accordingly well placed to contribute to, and to profit from, the development of science, but how central was science to the Company? Was it more decorative or symbolic than functional in its significance? What kind of science flourished under the Company? Who practised science and why? How was India represented in and through the science of the period? These are questions this chapter will attempt to explore.

THE COMPANY OF SCIENCE

The East India Company's Court of Directors in London exercised a commanding position in relation to science in India. One of the leading patrons of science in Britain itself, on the subcontinent the Company and its servants enjoyed a near monopoly over Western scientific activity. Anxious to preserve its commercial privileges and prevent outsiders from undermining its authority, the Company closely regulated European access to India. Its approval was essential for any kind of scientific expedition to be undertaken and the Company was disinclined to allow scientific visitors, however eminent they might be. Apart from the French naturalist and traveller Victor Jacquemont, who died in India in 1831, the greatest exception to the scientific monopoly of Company servants was the expedition to India in 1848–50 of **Joseph Dalton Hooker**,[1] the foremost botanist of nineteenth-century Britain. The German naturalist Alexander von Humboldt sought, but was never granted, permission to visit India.[2] Many leading British scientists of the period – Joseph Banks, Charles Lyell, and Charles Darwin among them – showed great interest in the natural history of India without ever visiting the country in person. Europe's scientists and collectors relied instead on informal networks of contacts with army officers, doctors and officials – or on the magnanimity of the Company itself – to provide them with specimens, drawings and scientific information.[3]

Through its control of the nomination of candidates for bureaucratic and military appointments in India, the Court of Directors commanded a vast fund of patronage and regulated access to one of the richest fields of scientific and technical employment available to Britons overseas. Even once taken into the Company's employment, those of its servants who wished to pursue scientific interests remained heavily dependent on the approval and funding of the Court of Directors or its most senior representative in India, the Governor-General. In the 1790s, in an early instance of its support for science, the Company paid £300 for the surgeon-botanist **William Roxburgh** to begin publication of his lavishly illustrated *Plants of the Coromandel Coast*. By the time of its completion in 1819, the three-volume work had cost the Company £2,000, but by then the market for such costly works of natural history had already collapsed. This 'commercial disaster' did much to discourage the Company from further acts of largess, to the dismay of later naturalists, who believed themselves entitled to similarly generous treatment.[4] In the 1840s, the

[1] Information on individuals whose names are in bold will be found in the Biographical Notes at the end of this book, pp. 214–16.

[2] Jean Théodoridès, 'Humboldt and England', *BJHS*, 3 (1966), pp. 43–4.

[3] Apart from Hooker, Darwin's India informants included three Company surgeons (J. G. Malcolmson, J. Forbes Royle and Hugh Falconer), a Madras civil servant, Walter Elliot, and the curator of the Asiatic Society's museum, Edward Blyth: Frederick Burkhardt and Sydney Smith (eds.), *The Correspondence of Charles Darwin*, vols. II–VII (Cambridge, 1986–91).

[4] Ray Desmond, *The European Discovery of the Indian Flora* (Oxford, 1992), pp. 47–50; Simon Schaffer, 'Visions of Empire: Afterword', in David Philip Miller and Peter Hanns Reill (eds.), *Visions of Empire: Voyages, Botany and Representations of Nature* (Cambridge, 1996), p. 343.

Company subsidised publication of **Hugh Falconer** and **Proby T. Cautley**'s catalogue of the Siwalik fossils from north India, promising to take forty copies at a guinea each. But, despite lobbying from the Royal Society and other scientific bodies in London, the Directors declined to pay for the full cost of classifying, illustrating and exhibiting the 40 tons of fossils Falconer and Cautley had shipped back from India. Forty guineas was a modest sum compared with the £1,000 donated by the British government.[5] The Court of Directors showed little interest, too, in giving Hooker the financial support he expected to publish his *Flora Indica*, the first and only volume of which appeared in 1855; the full publication of the single most important work of nineteenth-century Indian botany had to wait until after the abolition of the Company to find administrative favour and a suitable subsidy. It was not surprising, therefore, that, despite the effusive dedications and public tributes to the Company's 'princely' patronage, in private many men of science railed against the 'scoundrely' and 'knavish' conduct of those 'cheese-monger Emperors', the Court of Directors.[6]

Some historians have been at pains to show that the Company's scientific interests were not determined by purely material considerations but represented a more enlightened and disinterested approach to science. While accepting that the 'profit motive' necessarily 'guided the policies of the East India Company', Ray Desmond has contested the kind of argument that reduces all the decisions and actions of the Court of Directors to 'solely . . . commercial considerations'. He points out that the Directors 'founded and maintained . . . an unremunerative library and museum in Leadenhall Street in the City, were generous patrons of scholarly publications, and seldom opposed their officials pursuing Oriental studies'.[7] But, since the Company was under frequent attack for mismanaging Indian affairs, and given that science was a prestigious pursuit among Britain's ruling classes, it must, at the least, have been politically advantageous to be hailed as one of the 'most munificent patrons of science in the world'. It may have been the case that, conveniently, 'self-interest and scholarship often coincided',[8] but whereas the former was frequently in evidence, the latter, at best, received only erratic support.

From time to time the Court of Directors, or its principal representatives in

[5] Jack Morrell and Arnold Thackray, *Gentlemen of Science: Early Years of the British Association for the Advancement of Science* (Oxford, 1981), p. 352.

[6] Leonard Huxley, *Life and Letters of Sir Joseph Dalton Hooker*, I (London, 1918), p. 358; Marika Vicziany, 'Imperialism, Botany and Statistics in Early Nineteenth-Century India: The Surveys of Francis Buchanan (1762–1829)', *MAS*, 20 (1986), p. 626, note 5.

[7] Desmond, *Discovery*, p. v.

[8] T. J. Newbold, 'Summary of the Geology of Southern India', *JRAS*, 12 (1850), p. 95; Mildred Archer, 'India and Natural History: The Role of the East India Company, 1785–1858', *History Today* (November 1959), p. 736.

India, declared their high-minded attachment to science, recognising its promotion as the responsibility of a civilised government. Thus, in 1804, at a time of growing British ascendancy, the Governor-General, Lord Wellesley, declared that 'to facilitate and promote all enquiries which may be calculated to enlarge the boundaries of general science' was a duty 'imposed on the British Government in India by its present exalted situation'. Yet, as Marika Vicziany has shown in discussing the career of the naturalist **Francis Buchanan**, Wellesley was well aware of the value that scientific surveys might have in advancing his reputation and deflecting criticism of his expansionist policies.[9] Science could also serve more narrowly utilitarian ends. In 1787 a Polish botanist, Anton Hove, was sent by the Board of Trade in London (for once without Company approval) to report on cotton-growing and textile production in Gujarat, an area still under Maratha control. Disguised as an indigent physician, Hove reported extensively on agriculture, medicine and other matters of scientific and technological interest and shipped back several crates of plants for the botanic gardens at Kew, but the commercial and political motives behind his mission were ill concealed.[10]

As British power in South Asia grew, its human and material resources attracted the close attention of a revenue-hungry administration, and several scientific surveys were commissioned to provide the Company with more information about its newly acquired territories. Among the most important of these were the survey of Mysore under Colonel **Colin Mackenzie** between 1799 and 1810, the journey of Francis Buchanan from Madras through Mysore to Kanara in 1800–1, and Buchanan's survey of Bengal and Bihar, 1807–14. As with the scientific activities of the Company in general, these surveys have been the subject of growing scholarly debate. Were they driven by purely material considerations (arising from the Company's need to 'know' India the better to rule and exploit it), or did they express a wider vision of scientific needs and opportunities? Were they simply instruments in the imperial ordering of India, or did they represent the more explicitly scientific objectives of Company servants themselves? The issue is not easily resolved, for the surveys served a variety of purposes and the motives of individuals like Mackenzie and Buchanan were not necessarily those of their paymasters. In describing his own objectives for the Mysore survey, Mackenzie declared in 1800 that his intention was to 'obtain . . . a clearer and better

9 Deepak Kumar, *Science and the Raj, 1857–1905* (Delhi, 1995), p. 70; Vicziany, 'Imperialism', pp. 627–38.

10 A. P. Hove, *Tours for Scientific and Economical Research Made in Guzerat, Kattiawar, and the Conkuns, in 1787–88* (Bombay, 1855).

defined knowledge of the extent, properties, strength and resources' of the territory recently seized from the defeated state of Mysore. This would help to provide commercial intelligence for the Company, but it would also illuminate 'many objects of natural history' that would contribute to 'the improvement of scientific knowledge'.[11]

The directions given to Buchanan by the Court of Directors in 1807 for his survey of eastern India also combined matters that were directly relevant to the Company's financial interests with those that would appear to be of purely scientific or curiosity value. Buchanan was asked to report on the topography and natural resources of each district, its 'extent, soil, plains, mountains, rivers, harbours, towns and subdivisions', together with the 'air and weather', and whatever he might discover 'worthy of remark concerning the history and antiquities of the country'. With respect to 'the natural productions of the country', he was to enquire into the nature of animal, vegetable and mineral products, especially those used as food and medicine or in trade and manufacture; he was to enquire about fisheries, forests, quarries and mines. Agriculture, too, was to receive attention – from crops, implements, and livestock to the general state of farms and landed property. He was further to report on the inhabitants of the region, their customs, commerce and manufacturing. Finally, he was to 'take every opportunity of forwarding to the Company's Botanical Garden [in Calcutta] . . . whatever useful or rare or curious plants and seeds' he discovered and such 'observations' as might be necessary for their cultivation. The phrase 'useful or rare or curious' aptly conveys the intermingling of the functional and the ornamental in early Company science, though it is clear that the matters Buchanan was most persistently called upon to investigate were those most likely to prove of material worth.[12] However, Buchanan's personal preference, like that of many other Company servants, was for natural history, above all his 'beloved botany'. As Vicziany points out, in his surveys Buchanan was greatly influenced by the model of Sir John Sinclair's *Statistical Account of Scotland* and its underlying doctrine of 'improvement', a term that repeatedly surfaces in Buchanan's account of war-ravaged Madras and Mysore.[13] With their concern for wealth, resources, and means of subsistence, for population, climate, irrigation, and customs, these early surveys might best be understood as early essays in what Michel Foucault called 'governmentality', though this was punctuated, in Buchanan's case, by

[11] Kumar, *Science*, p. 33; Peter Robb, 'Completing "Our Stock of Geography", or an Object "Still More Sublime": Colin Mackenzie's Survey of Mysore, 1799–1810', *JRAS*, 8 (1998), pp. 181–206.

[12] Francis Buchanan, *An Account of the Districts of Bihar and Patna in 1811–1812* (Patna, 1934), pp. i–iv.

[13] Vicziany, 'Imperialism', pp. 643–4, 648–9.

outbursts of a Romantic sensibility to landscape, most evidently in his descriptions of waterfalls and forests.[14]

Although the surveys of Mackenzie and Buchanan have attracted considerable historical attention and demonstrate the extent to which the Company and its servants at times sought systematically and in a self-consciously scientific way to map and compile inventories of newly acquired territories, they were to some extent exceptional for the period. In the main the Company did not initiate scientific projects, but merely tolerated its employees' private pursuits. Army officers, civil servants, engineers and physicians might satisfy their cultured curiosity or while away their leisure hours by keeping meteorological records, hunting for fossils, or compiling notes on local flora and fauna, but that did not necessarily interest or concern their superiors in Calcutta or London. Indeed, the nature of Company rule and the burden of official duties might do more to obstruct than to facilitate the pursuit of 'recreational' science. Few Europeans in India had the time and opportunity to dedicate themselves wholeheartedly to science. 'A mere man of letters, retired from the world and allotting his whole time to philosophical or literary pursuits' was said in 1788 to be 'a character unknown among Europeans resident in India'. Everyone was 'constantly occupied either in the affairs of Government, in the administering of justice, in some department of revenue or commerce, or in one of the liberal professions'.[15] Unlike in Britain, there were few European clergymen, landlords and manufacturers to produce papers on natural history or patronise fledgling scientific societies. A want of time for 'general researches' dogged even those in the Company's medical service, like the botanist Roxburgh, and constituted the principal 'obstacle to the progress of knowledge' as they understood it.[16] Several among those who had begun to establish scientific reputations died young or returned to Britain and so were lost to India. Rarely did European men of science retire in the country. **B. H. Hodgson**, who wrote prolifically on Himalayan zoology and ethnography between the 1820s and his eventual return to Britain in 1858, was a rare example of a naturalist who elected to stay on, following his resignation from government service in 1843.[17]

[14] Michel Foucault, 'Governmentality', in Graham Burchell, Colin Gordon and Peter Miller (eds.), *The Foucault Effect* (Chicago, 1991), p. 93; Francis Buchanan, *Journey from Madras through the Countries of Mysore, Canara, and Malabar* (London, 1807), I, pp. 126, 170; II, pp. 24, 166–7. For tensions between these ideas in Buchanan's homeland, see Peter Womack, *Improvement and Romance: Constructing the Myth of the Highlands* (Basingstoke, 1989).

[15] Rajendralal Mitra, 'History of the Society', *Centenary Review of the Asiatic Society of Bengal from 1784 to 1883* (Calcutta, 1885), p. 18.

[16] Kumar, *Science*, p. 66.

[17] William Wilson Hunter, *Life of Brian Houghton Hodgson* (London, 1896).

Far from embodying the rule of science in the service of empire, the Company's involvement in science often appeared more like a fitful flirtation. From time to time, when its economic and political interests were aroused, or the case for some scientific endeavour was convincingly made, science could command the Company's active attention, but for much of the period it was of secondary importance compared with the more pressing concerns of revenue, diplomacy, law and order. The British enjoyed the company of science; it would be excessive to suggest that they ruled by it. A large part of the science conducted in India before 1858 accordingly belonged not to the state but to the tradition of 'gentlemanly' science that flourished in Britain until the mid-nineteenth century. It mostly lacked a specialist state agency and a clearly defined agenda. Those who spoke for India's science, whether in Britain or in South Asia, frequently found the Court of Directors and the Government of India perplexingly uninterested, even on matters that seemed of material value to the Company. The lack of official support for an Indian branch of the British Association for the Advancement of Science in the 1830s was indicative of this apparent unconcern.[18] In the circumstances, as H. J. C. Larwood observed, 'the enthusiasm with which scientific interests were pursued and the bulk of work produced was remarkable', though recent scholarship is far less disposed to accept his conclusion that much of the work done by scientists in the Company period was 'of little permanent value'.[19]

Until the 1840s and 1850s, army engineers (such as Mackenzie) and surgeons (such as Buchanan) were called upon to furnish the administration with all-purpose expertise without the expense and delay of recruiting specialists from abroad. Only towards the end of the Company era, as scientific disciplines grew more specialised and the requirements of scientific administration more taxing, were outsiders recruited for Indian service. In an innovative move, in 1851 Thomas Oldham, previously Director of the Geological Survey of Ireland, arrived to take charge of what five years later became the Geological Survey of India. But even then the resources placed at his disposal – an office, a clerk and a *chaprassi* – were far from adequate for the task in hand and suggested the Company's still limited practical commitment. With the partial exception of the Great Trigonometrical Survey of India, which dated from 1818 but again drew on the army for its personnel, dedicated scientific and

[18] Morrell and Thackray, *Gentlemen*, pp. 502–3.

[19] H. J. C. Larwood, 'Western Science in India before 1850', *JRAS*, Part 2 (1962), p. 76; cf. Satpal Sangwan, 'From Gentlemen Amateurs to Professionals: Reassessing the Natural Science Tradition in Colonial India, 1780–1840', in Richard H. Grove, Vinita Damodaran and Satpal Sangwan (eds.), *Nature and the Orient: The Environmental History of South and Southeast Asia* (Delhi, 1998), pp. 210–36.

technical agencies had barely begun to emerge from the matrix of the military and medical services before the 1850s. It is necessary, therefore, to look beyond the formal parameters of state science to establish the general character and significance of science in the Company period.

THE ORGANISATION OF COLONIAL SCIENCE

Much of the scientific endeavour of the Company period took place outside, or on the margins of, state institutions. Many early accounts on Indian geology, for instance, were written by military officers and army surgeons not as part of their official duties but under the stimulus of personal interest and in the course of cross-country marches. Thus, Captain Franklin of the Bengal Army compiled his pioneering observations on the geology of central India during a march through Bundelkhand in 1826–7; Assistant Surgeon Hardie slipped away from his regiment while marching from Baroda to Udaipur to examine wayside rocks, later apologising to his readers for not having been able to carry out more systematic investigations. As a by-product of troop movements, such accounts were bound to be superficial, but they sketched in the first outlines of Indian stratigraphy.[20]

Some of the most significant discoveries of the period were made without official sponsorship, or even much prior knowledge of a particular science. A critical example was the unearthing of the Siwalik fossils in November 1837, a momentous event for Indian palaeontology and for wider discussions of climatic change and extinct mammalian species. Hugh Falconer, a young Company surgeon and Superintendent of the Saharanpur Botanic Garden, followed up earlier finds made in October 1834 by Lieutenant Proby T. Cautley of the Bengal Engineers and his assistants W. E. Baker and H. M. Durand while excavating the Jumna Canal. As in Britain, major engineering works of this kind created unique opportunities for geological discoveries, but Falconer was also the beneficiary of indigenous knowledge: the local raja, who possessed a huge mastodon molar (known as 'the tooth of Deo'), advised him where to dig for further specimens and in six hours 300 fossil bones were uncovered.[21]

The discovery and identification of the Siwalik fossils established the scientific reputations of Falconer and Cautley in Europe, and they became joint recipients of the Geological Society's prestigious Wollaston Medal in

[20] James Franklin, 'On the Geology of a Portion of Bundelkhand, Boghelkhand, and the Districts of Sagar and Jebelpur', *AR*, 18 (1833), pp. 23–46; James Hardie, 'Remarks on the Geology of the Country', ibid., pp. 82–99.

[21] E. W. C. Sandes, *The Military Engineer in India*, II (Chatham, 1935), pp. 275–7.

1837. Cautley returned to his canal, Baker and Durand's official duties left them little time for amateur geology, but Falconer, still under 30, became an influential figure in British geology. Although obliged to return to India, he was elected a Fellow of the Royal Society in 1845 and served as a member of its Council and as Vice-President of the Geological Society until his death in 1865. Falconer's career (like that of his contemporary, the surveyor **George Everest**) demonstrated how India could provide a springboard for a metropolitan reputation and its accompanying honours.[22] Andrew Grout has argued that the award of the Wollaston Medal had 'great symbolic value', not just for Falconer and Cautley, but for all geologists working in India. 'It showed that the field was still open to enthusiastic amateurs, and it was taken as evidence that the geology of India, and those labouring in its elucidation, were considered important by metropolitan savants.'[23] And yet it was suggestive of the relative backwardness attributed to colonial science that, in presenting the medal in 1837, Lyell pointed out that when Falconer and Cautley made their discovery they were not 'versed in fossil osteology' and, 'being stationed on the remote confines of our Indian possessions', were far from any 'living authorities' or standard work of palaeontology. Lyell commended 'the manner in which they overcame these disadvantages, and saw the enthusiasm with which they continued for years to prosecute their researches, when thus isolated from the scientific world' as being 'truly admirable', but the imputation was, none the less, that science in the colonies was inevitably a more amateurish pursuit than in the metropole.[24] Falconer was himself loath to leave London to resume his colonial 'isolation', and Darwin and Hooker, too, regarded his return to India as a significant loss to metropolitan science. Once back in Calcutta, Falconer showed his displeasure by being petulant and snobbish towards the Asiatic Society, the body that had first brought the Siwalik fossils to international attention.[25]

Whether justified or not, an acute sense of isolation haunted the geological science of the Company period. When combined with British empiricism, it bred a science that was as diffident as it was dependent. The surgeons, engineers and army officers who first wrote about geology often lamented their

[22] Horace B. Woodward, *The History of the Geological Society of London* (London, 1907), pp. 128–9, 199; Matthew H. Edney, *Mapping an Empire: The Geographical Construction of British India, 1765–1843* (Chicago, 1997), p. 147.

[23] Andrew Grout, 'Geology and India, 1770–1851: A Study in the Methods and Motivations of a Colonial Science', Ph.D., University of London, 1995, p. 83.

[24] P. N. Bose, 'Natural Science', in *Centenary Review*, p. 61.

[25] Hooker to Darwin, 25 March 1846, in Burkhardt and Smith (eds.), *Correspondence*, III, p. 305; Hooker to Darwin, 13 October 1848, *Correspondence*, IV, p. 172.

own lack of expertise. They saw themselves as amateurs, essentially confined to 'collecting and recording with precision'; this was (to their minds) a worthy enough task but its main function was to provide the raw data that more expert minds in Europe might evaluate and incorporate into wider systems of scientific knowledge. 'I am not learned enough in the science to become an advocate for any party', observed Franklin, alluding to the Huttonian–Wernerian controversy that had dogged British geology earlier in the century; 'a few lessons when in England, and the great volume of nature have been my chief guide'. All he aspired to was 'to record facts, to lay down strata correctly though not minutely on a map, [and] to extract that which is useful or profitable in the science'.[26] There was a feeling, too, not confined to geology, that even the most talented scientific minds in India failed to attain their full potential or receive the recognition they deserved. The *Calcutta Review* claimed that James Prinsep, who wrote more than sixty articles for the Asiatic Society between 1825 and 1839 on subjects as diverse as meteorology, geology and numismatics, could have become 'the Humboldt of the east' had he only 'been spared to us', but he died in 1840, aged only 41. Despite the zeal and energy displayed by Company scientists, their talent, it seemed, was spread thinly and over too many fields, or official duties prohibited a more single-minded pursuit of science. Even those who gained a reputation outside India – such as Falconer, Everest, and the surgeon-botanist **J. Forbes Royle** – felt like novices when they first ventured into scientific circles in Britain.[27] Nor was the isolation that Lyell referred to much diminished by the end of the Company period. 'We labour under immense disadvantages in this country in the want of books of reference and collections for comparison', remarked Thomas Oldham in 1856. 'We are working under the same difficulty that would affect a tradesman without his tools or a physician without medicines.' In these circumstances it was 'utterly impossible to attain the same progress which should be looked for in Europe'.[28]

Not all science under the Company was as itinerant as Buchanan's surveys or as fortuitous as finding the Siwalik fossils. Up-country surveys, missions of scientific reconnaissance and opportunistic observations during troop marches and canal works were supplemented by the science of city-based learned societies, journals and museums, and these, as much as official policy and patronage, helped shape the character of colonial science. The earliest and most celebrated of India's learned societies, the Asiatic Society of Bengal, was

[26] Franklin, 'Geology', p. 37. [27] 'Works on the Himalayas', *CR*, 4 (1845), pp. 163–5.

[28] Satpal Sangwan, 'Reordering the Earth: The Emergence of Geology as a Scientific Discipline in Colonial India', *IESHR*, 31 (1994), p. 305.

established in Calcutta in January 1784 on the initiative of the judge and Orientalist Sir William Jones. Though inspired by the Royal Society in London (one early indication of the role that the Royal Society was to play as model and mentor for science in India throughout the colonial period), the Asiatic Society was not primarily a scientific body.[29] However, in the absence of the kinds of specialised scientific societies that flourished in London after the founding of the Geological Society in 1807, it functioned as the main platform for Western science in India until replaced by the Indian Science Congress in 1914. Articles on scientific topics appeared intermittently in the Society's *Asiatic Researches* between 1788 and 1839, but, like the Company itself, it showed greater favour towards literary and linguistic studies. In 1808, in an attempt to encourage more scientific contributions, a committee was established 'to promote the knowledge of natural history, philosophy, medicine, improvements of the arts and sciences, and whatever is comprehended in the general term physics'.[30] The 'Physical Class', though revived in 1828, met only erratically and attendance was poor. By the 1830s the Asiatic Society of Bengal was competing with other scientifically oriented Calcutta societies, including the Agricultural Society set up in 1820 and the Medical and Physical Society in 1823. Beyond Bengal, comparable societies also came into existence, notably the literary, scientific and medical societies of Bombay and Madras.[31] The Royal Asiatic Society in London, founded in 1823, provided a further forum for the presentation and discussion of Indian material and, by virtue of its location, was more closely integrated into the world of metropolitan scientific societies.

Museums, too, were important not just as sites for the pursuit of scientific knowledge but as a way of establishing the reputation and self-esteem of colonial science. Although vast quantities of botanical, zoological and geological specimens were sent to London to form part of the Company's India Museum or for distribution to Continental collections, many were retained in India. As the region's premier scientific body, the Asiatic Society was anxious that its collection (including thousands of rock and mineral specimens) should be properly housed and displayed and that Calcutta should have a museum that would vie with institutions in Europe and yet be a scientific window onto India. First proposed by the naturalist **Nathaniel Wallich** in 1814, the museum was intended 'for the reception of all articles that may tend to illustrate Oriental

[29] O. P. Kejariwal, *The Asiatic Society of Bengal and the Discovery of India's Past, 1784–1838* (Delhi, 1988).

[30] 'Introduction', *AR*, 18 (1833), p. i.

[31] A. Neelameghan, *Development of Medical Societies and Medical Periodicals in India, 1780–1920* (Calcutta, 1963).

manners and history, or to elucidate the peculiarities of art and nature in the East'.[32] The Bombay Literary Society, founded in 1804, followed suit with its own museum of natural history and antiquities in 1815. Museum collections had their practical uses. In 1835 the Government of India, enticed by prospects of exploiting coal and other minerals, decided to found its own museum of economic geology, initially entrusting the task to the Asiatic Society before, in 1856, transferring the collection to the Geological Survey.

Museums were also one of the institutional sites on which a more professionalised science was beginning to be established. In 1841 the zoologist Edward Blyth was sent out from England as the Society's full-time museum curator, a post he held until 1862. His appointment, paid for by the Company, has been seen as initiating a new phase in the history of colonial science in India, but his predicament was also indicative of the constraints on scientific endeavour in this period. As a Company employee, Blyth was tied to his official duties and needed permission even to leave Calcutta. In fourteen years, he lamented to Darwin in 1855, he had 'hardly been out of' the city and lacked the 'great advantages of travel and personal observation elsewhere'. Poor pay and the want of books, space and competent assistants left Blyth desperate to return to England.[33]

In an age in which the printing press assumed an indispensable role in the dissemination of scientific ideas,[34] journals, too, had a prominent place in nurturing Western science in India. Not only did they emulate the practice of learned societies in Europe; they also helped to maintain contact between educated Europeans scattered across India and adjacent territories, and served as a means by which scientific observation and speculation could be relayed to and from India. In 1829 Captain J. D. Herbert, Deputy Surveyor-General, launched the monthly journal *Gleanings in Science*. Intended as both a digest of scientific articles from Europe and a vehicle for local communications, *Gleanings* was soon swamped by the latter, which ranged with little discrimination from the introduction of steamboats on the Hooghly to ways of keeping wine cool in India. One reviewer complained that, despite the wealth of opportunity India presented for scientific study, the Asiatic Society had neglected physical science and natural history; Jones's interests had been predominantly literary and the government of a foreign country was bound to attach more importance to language than to science.[35] No less discouraging

[32] B. V. Subbarayappa, 'Western Science in India up to the End of the Nineteenth Century AD', in D. M. Bose, S. N. Sen, and B. V. Subbarayappa (eds.), *A Concise History of Science in India* (New Delhi, 1971), pp. 528–9.

[33] Burkhardt and Smith (eds.), *Correspondence*, v, pp. 392, 401.

[34] Cf., John Ziman, *The Force of Knowledge: The Scientific Dimension of Society* (London, 1976), pp. 97–9.

[35] 'Analyses of Books', *Gleanings*, 1 (1829), p. 211.

than the indifference of the state was the apathy of the public. At a time when the Geological Society in London could boast of having more than 700 members, membership of the Asiatic Society seldom exceeded 250: in 1845 it sank to a miserable 119. The weekly sessions with which the Society began had dwindled by 1799 to monthly meetings. India's other learned societies could expect even fewer supporters and subscribers. In 1825 the Medical and Physical Society of Calcutta had just over 200 members. In 1829 the editor of *Gleanings* estimated that the journal-reading public in Bengal numbered no more than 2,000. Three years later, *Gleanings* was taken over by the Asiatic Society and incorporated into the *Journal of the Asiatic Society*, which over the next fifty years published several hundred papers on scientific subjects.[36]

Undeterred by the fate of *Gleanings*, several other scientific and medical journals sought to establish themselves between the 1820s and 1850s. They included the *Calcutta Journal of Natural History*, launched in 1840 by Surgeon John M'Clelland, who wrote many of the early articles himself. His opening editorial was not auspicious: 'The usual apology for being without a periodical in the metropolis of British India exclusively devoted to objects of science is that it would not pay.' He was determined, none the less, to put Calcutta's 'taste to the test'.[37] He also hoped the *Calcutta Journal* would become the focus for an Indian branch of the British Association for the Advancement of Science, believing a periodical especially necessary for this purpose in India, where 'the cultivators of science are so few, and the nature of their various duties such as to prevent their assembling at any one place'.[38] But the idea failed to win support and the journal folded in 1847.

Many of the journals of the period set out to educate and inform their readership in ways that suggest the importance of science less as an instrument of state than as a means of promoting the cultural cohesion and social identity of the European elite. It has been argued that in an increasingly class-riven Britain scientific societies helped give a sense of solidarity and collective purpose to the new, urban middle class: science symbolised order in a world threatened by rapid social change and working-class militancy.[39] Matthew Edney has similarly argued that the pursuit of science in India helped to differentiate the European elite from both Indians and British soldiers, merchants and planters.[40] Science certainly served to promote and preserve a sense of cultural commonality among educated Europeans in India while helping them to maintain contact with cultured society in Europe. It reassured the colonial elite that they

[36] Subbarayappa, 'Science', p. 500. For further discussion of the nature and significance of scientific publications in this period, see Grout, 'Geology and India', pp. 87–104.
[37] *CJNH*, 1 (1840), p. 1. [38] Ibid., p. 8. [39] Morrell and Thackray, *Gentlemen*, pp. 22–31.
[40] Edney, *Mapping*, p. 33.

belonged to a world of metropolitan taste – or could gain ready access to it. The editor of a volume of *Asiatic Researches* devoted to geology maintained that every European in India was capable of making some contribution to science. 'Scattered as are our countrymen in the East, over so large a portion of the surface of the earth as yet unexplored by science, the most common observer can hardly fail to notice phenomena that may be important for the purpose of physical research.' The 'unscientific enquirer' might do little more than collect and observe, but he (the assumption was invariably masculine) could pass his data on to others better able to use them, or, through self-instruction, he could readily acquire a 'more accurate knowledge' for himself.[41] The *Calcutta Review*, launched in 1844, also took its didactic responsibilities seriously. Its declared intention was to bring together 'useful information' and 'sound opinions' about Indian affairs, and to 'conduce . . . directly or indirectly, to the amelioration of the condition of the people'. 'The bane of this country is ignorance', the editor declared, not the ignorance that existed in the 'dark recesses of native life', but that which existed 'in high places – among the ruling body – among the men to whom inscrutable Providence has submitted the destinies of India'.[42]

Implicit here, as in much of the scientific literature of the period, was criticism of the Company for not being better informed about, or more receptive to, science. But the *Review*'s passing reference to 'the dark recesses of native life' highlights another aspect of European science under the Company – its externality. Despite declarations, like that made by the Governor-General, Lord Bentinck, in 1835, that the 'great object' of the British government in India 'ought to be the promotion of European literature and science among the natives of India',[43] when it came to scientific societies, museums and journals, it was evident that Western science was primarily about India and Indians, and only secondarily for and by them. The founding members of the Asiatic Society were all Europeans, and Jones in his inaugural address left open for later consideration whether Indians should be allowed to join. Though papers were from time to time submitted and read on their behalf by European members, no Indians were admitted to membership of the Society until 1829. Thereafter they were actively involved, including Ramkamal Sen, who served from 1838 as its 'native secretary' and donated many items to the Society's museum. In its early years, too, the Bombay Literary Society had as much a social function as an intellectual agenda: 'Its members formed a select

[41] *AR*, 18 (1833), p. ii. [42] *CR*, 1 (1844), p. ii.
[43] John Rosselli, *Lord William Bentinck: The Making of a Liberal Imperialist, 1774–1839* (London, 1974), p. 220.

circle of high-placed Europeans who met together for mutual friendship as well as for "the feast of reason and flow of soul".' When, after 1840, as a 'natural consequence of the growth of education in the country', Indians began to be admitted, 'it involved a considerable departure from the original design'.[44]

It would, nevertheless, be a mistake to see Indians as totally isolated from the scientific enterprise of the period. A striking example of their direct engagement was the career of Bal Shastri Jambedkar, a Brahmin from Ratnagiri district, who became secretary to the Bombay Educational Society in 1827 at the age of 17 and translated Lord Brougham's *Treatise on the Objects, Advantages and Pleasures of Science* into Marathi. He became 'native secretary' to the Oriental Translation Committee of the Bombay branch of the Royal Asiatic Society, working alongside British Orientalists. When Elphinstone College was established in 1834 he became a professor of mathematics and, as well as teaching astronomy and mathematics, translated scientific works into Marathi. He also encouraged Indian interest in chemistry, natural history and other aspects of the 'useful' knowledge of the West through his Anglo-Marathi journal, the *Darpan*. The journal, and its successor *Dig Darpan*, reflected the attitudes and concerns of the first generation of Western-educated in Bombay, 'convinced of the need for an expansion of India's intellectual horizons and for a revaluation of her traditional social and religious beliefs'.[45] Perhaps because it had a more practical programme than the Asiatic Society, Calcutta's Agricultural and Horticultural Society had from its earliest years Indian officers and members, including such leading *bhadralok* figures as Dwarkanath Tagore and Radhakanta Deb. In keeping with its wider purpose of 'improvement' and the dissemination of 'useful' agricultural knowledge, some of the Society's *Transactions* appeared in Bengali. It is important, then, not to assume that Indians were merely passive spectators or simply informants in relation to the Western science of the Company period. There is no doubt that in Calcutta, as in Bombay, middle-class Indians were both attracted by the practical application of Western science and technology and anxious to understand how they had given their British rulers such a remarkable ability to control and exploit the material world.[46]

[44] R. Scott, 'History of the Society', *Journal of the Bombay Branch of the Royal Asiatic Society: Centenary Memorial Volume* (Bombay, 1905), pp. 17, 23.

[45] Rosalind O'Hanlon, *Caste, Conflict and Ideology: Mahatma Jotirao Phule and Low Caste Protest in Nineteenth-Century Western India* (Cambridge, 1985), pp. 90–2.

[46] Jim Masselos, 'The Discourse from the Other Side: Perceptions of Science and Technology in Western India in the Nineteenth Century', paper presented at the American Asian Studies Association annual conference, Boston, 1987.

SCIENCE AND ORIENTALISM

The involvement of Indians in the scientific activities of the Company period brings us back to the question of the relationship between Western science and indigenous knowledge. In contrast to much previous scholarship, which has tended to emphasise the discontinuities that resulted from the advent of British rule, C. A. Bayly has recently argued that the 'colonial information order' was 'erected on the foundation of its Indian precursors'. Between the 1780s and 1870s, 'beyond the purview of British institutions', the agents and representatives of the older systems of knowledge survived 'traumatised, but recognisably the same'.[47] Just as Indians assimilated and adapted Western doctrines and technologies, so Western scholars and administrators embarked on a protracted intellectual engagement with Indian epistemologies that lasted well into the nineteenth century. Despite British rule, Indian systems of information and knowledge retained a high degree of autonomy and hence remained relatively inured to colonising attempts to combine political control with cultural hegemony.

Although the present work is only marginally concerned with the processes of intelligence-gathering and social communication that Bayly describes, his book also discusses other arenas of cultural engagement, such as astronomy, botany and medicine, which are more central to this discussion, and it forcefully poses the question of how closely Western science in India drew upon, or was even dependent upon, Indian ideas and information. Our historical understanding of 'colonial discourse', Bayly argues, 'must reflect the pervasiveness of Indian agency, of the Indian intellectual challenge, and of Indian cultural vitality'.[48] Although Bayly's attention is largely directed elsewhere, one place to begin considering the role and extent of the Indian contribution to the science, technology and medicine of the Company period is by looking at the institutional sites and discursive practices of colonial science itself.

Although in some respects India seemed to be located on the outer peripheries of metropolitan science, European scholars and scientists in India often saw themselves as possessing unique opportunities and responsibilities. In his opening address to the Asiatic Society in 1784, Sir William Jones laid down a challenging agenda for its members, one that gave the Society a crucial role in the scientific investigation of Asia's society, history and environment. He directed them to examine whatever was 'rare in the stupendous fabric of

[47] C. A. Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India, 1780–1870* (Cambridge, 1996), p. 179. [48] Ibid., p. 314.

nature', to revise the geography of Asia through 'new observations and discoveries', and to 'trace the annals and . . . traditions of those nations who, from time to time, have peopled or desolated it'. They were to illuminate the forms of government, the civil and religious institutions of the people of Asia, enquire into their astronomy, arithmetic and geometry, their systems of morality, grammar and rhetoric, their skill in medicine and surgery, their knowledge of chemistry and anatomy. The Society was to examine the agriculture, manufacturing and trade of Asia, its music, architecture and painting, even its pottery. In short, it was to reveal every aspect of 'man and nature' in Asia, 'whatever is performed by the one or produced by the other'.[49]

As Thomas Trautmann has recently argued in tracing the background to Jones's linguistic theories,[50] this wide-ranging intellectual agenda can be seen as part of an attempt to bring India and its newly discovered arts, sciences and history into a closer and more intelligible relationship with Western knowledge in a culture still dominated, despite its Enlightenment credentials, by biblical notions of the origins of race and language and of the earth's antiquity. This task was to be achieved by establishing the relationship of India's peoples and languages to those of Europe (an aim exemplified by Jones's discovery of the shared origins of Sanskrit, Greek and Latin); by comparing the traditions of the Bible with the legends of the Hindus to arrive at a mutually agreed chronology; and (one might add) by exploring the 'family' connections that linked Asia's flora and fauna, as surely as its human inhabitants, to their European kith and kin. Orientalist scholarship between the 1770s and 1840s was more, therefore, than an objective 'discovery' of India or an impartial appraisal of Eastern knowledge. In as much as one can ascribe to them a single, common agenda, the Orientalists attempted to situate India materially and culturally relative to Europe and in the process to learn from the East whatever might serve to improve or enrich their own civilisation. In common with wider Enlightenment attitudes towards non-European societies, this involved a search for correspondences and connections but it also ultimately entailed a pursuit of difference and the unfolding of a hierarchy of nations from the most primitive to the most civilised.[51] India's knowledge of itself was seldom deemed adequate or complete, but needed to be supplemented and contextualised by Western understanding. When it came to science, Jones declared in one of his more intemperate utterances, 'Asiatics' were 'mere children'.[52]

49 Mitra, 'History', pp. 4–5.

50 Thomas R. Trautmann, *Aryans and British India* (Berkeley, CA, 1997).

51 John Gascoigne, *Joseph Banks and the English Enlightenment: Useful Knowledge and Polite Culture* (Cambridge, 1994), pp. 119–83.

52 Trautmann, *Aryans*, p. 60.

Moreover, as befitted the wider Enlightenment project, Orientalism embraced 'nature' as well as 'man' and so brought a European scientific understanding of the natural world to bear on the assessment of India's material and cultural existence. It brought together (as in Prinsep's works), and without clear disciplinary distinction, philology, numismatics, ethnology, zoology, geology, and meteorology, even if, as in the Asiatic Society, language, literature and religion seemed initially to offer more fruitful avenues of enquiry into India than the natural sciences.

The underlying attitude of superiority to indigenous science can be briefly illustrated by reference to Indian astronomy, which attracted much attention in early Orientalist scholarship and which Bayly cites as an example of the contacts and continuities that existed between indigenous and Orientalist knowledge. Astronomy was one of the most technically accomplished sciences in eighteenth-century Europe, and it is not surprising that it should be well represented among the sciences of the Company period. It was also of great practical value since, until reliable timepieces and accurate surveying techniques were developed, the determination of longitude for navigation and map-making depended on observations of the moon and eclipses of Jupiter's satellites. Evidence of an ancient, still extant, astronomical tradition in India naturally aroused curiosity and suggested an area where the West might with profit learn from the East. Astronomy also raised intriguing questions about the antiquity of Indian civilisation and the extent of its technical and scientific achievements. The observatories built by Raja Jai Singh in the early eighteenth century drew appreciative comment from many European travellers. In 1777 a carefully annotated account of the observatory at Benares, reputedly dating from the age of Akbar, if not earlier, was presented to the Royal Society; its author praised the 'mathematical exactness' of the stone instruments but cast doubt on the knowledge of contemporary Brahmins.[53] Following sightings made in India in the 1760s of comets, eclipses and the transit of Venus, observatories were built between 1792 and 1842 by the Company or its Indian allies at Madras, Calcutta, Lucknow, Trivandrum and Poona. These reflected the extent of mutual interest in astronomy but, for the Company, practical needs were generally uppermost. Michael Topping, Superintendent of the Madras Observatory, thus described astronomy as 'the parent and nurse of navigation'. He hoped to see 'the charts of these eastern seas in a more correct state than those even of Europe; or at least a regular system established for the perfection of Indian geography'. His successor, John Goldingham, pursued this

[53] Sir Robert Barker, *An Account of the Bramins Observatory at Benares* (London, 1777).

essentially pragmatic goal by preparing two volumes of data on the satellites of Jupiter. Astronomers tried subsequently to develop a wider scientific role for their observatories but, like many other scientists in India, they found that they were expected to perform so many routine technical and administrative duties that they had little time to pursue scientific research.[54]

At first astronomy seemed a likely bridge between Western and Indian scientific knowledge. Orientalists not only noted the design and working of Indian observatories, but also, like H. T. Colebrooke, wrote sympathetically on Hindu astronomy. Europeans were employed as astronomers at Indian courts, including that of the Nawab of Awadh, who in 1831 appointed J. D. Herbert as the superintendent of his Lucknow observatory. A further stimulus to British interest in Indian astronomy was a paper by the Scots mathematician John Playfair in 1789 on 'the Astronomy of the Brahmins'. This took up the idea, earlier propounded by the French astronomers Le Gentil and Bailly, that Indian astronomy was not part of the Western astronomical tradition, traceable back to the ancient Middle East, but an entirely separate system, dating from as early as 3000 BC, and which had produced astronomical observations and predictions of astounding accuracy. Playfair's assertions in turn attracted the attention of the Asiatic Society, but, Trautmann claims, 'the question was never whether Indian astronomy had something new to offer Europe'. The aim was rather to assess the antiquity of Indian astronomy 'using the modern astronomy of Europe as the standard and means of investigation'.[55]

Although European interest in Hindu astronomy resurfaced periodically, its practical value and scientific worth were viewed with growing scepticism. A writer in the *Calcutta Review* in 1844 acknowledged that the Hindus had at a very early date been able to predict eclipses of the sun and moon with 'very considerable accuracy', but thereafter (following the standard Orientalist line) he believed that Indians had not only failed to advance further but actually 'retrograded in their knowledge of the principles of science'. Nor was that all. Far from being of great antiquity, one of the principal texts, the *Surya Siddhanta,* was now said to date only from the eleventh to thirteenth centuries AD and to be based on certain simple (and largely erroneous) principles rather than on actual observation. The author went on to declare that the 'Puranic system' of astronomy, geography and chronology was 'such a mass of absurdity and monstrous folly, that we should listen very favourably to any proposal that should promise to drive it out of the minds of the people'. It seemed to be formed

[54] S. M. Razaullah Ansari, 'The Establishment of Observatories and the Socio-Economic Conditions of Scientific Work in Nineteenth Century India', *IJHS*, 13 (1978), pp. 62–71; Subbarayappa, 'Science', p. 494. [55] Trautmann, *Aryans*, pp. 79–80.

'with the special view of defying all verisimilitude, and showing the extent to which a corrupt imagination can proceed in the conception of monstrosity'. It was 'by actual measurement and actual inspection, by the measuring-rod, the theodolite and the telescope, that the Puranic idol' was to be 'demolished'.[56] As T. B. Macaulay had put it no less scathingly nine years earlier, Indian astronomy so defied credibility that it would 'move laughter in girls at an English boarding school'.[57]

Further evidence of the yawning gulf between Western science and Indian knowledge can be found in botany, a science which, following Linnaeus, had become a 'project of rationalisation, an effort to create a set of concepts and procedures that would bring uniformity, consistency, and coherence to the representation of a clearly defined domain of natural objects'.[58] As overseas expeditions left Europe 'drowning in [plant] novelties', taxonomy assumed vital importance in trying to keep track of different species and to establish a common system of plant identification. Linnaeus's binomial taxonomy and his sexual system of classification system, though the latter was later abandoned in favour of the 'natural system', suggested relatively simple means by which plants could be identified and compared worldwide.[59] Jones favoured giving Indian plants 'their true Indian appellations', using romanised Sanskrit, claiming that Linnaeus would have done likewise 'had he known the learned and ancient language of this country'. He urged botanists to study Sanskrit, to gain a better knowledge of India's medicinal plants and draw upon Indian botanical expertise.[60] But Jones's advice was largely ignored. In his *Flora Indica* Roxburgh used a motley brew of Sanskrit, Bengali, Arabic, Persian, Hindustani and Hebrew. A generation later, Buchanan recommended the use of Sanskrit place and plant names, on the grounds that these were 'known to all Hindus of learning', but he was hardly consistent in this himself.[61]

By the early nineteenth century Indian plant taxonomy was an increasingly vexed issue and reflected the wider problem of how to utilise indigenous knowledge and informants without compromising the credentials of European science. Peripatetic naturalists like Buchanan relied heavily upon information from guides and translators, but they did not want to appear over-

56 'The Astronomy of the Hindus', *CR*, I (1844), pp. 258, 287–8.

57 Macaulay's 'Minute on Education' (1835), in W. T. de Bary (ed.), *Sources of Indian Tradition*, II (New York, 1968), pp. 44–6.

58 John E. Lesch, 'Systematics and the Geometrical Spirit', in Tore Frängsmyr, J. L. Heilbron and Robin E. Rider (eds.), *The Quantifying Spirit in the 18th Century* (Berkeley, CA, 1990), p. 75.

59 David Philip Miller, 'Introduction', in Miller and Reill, *Visions*, p. 8.

60 Desmond, *Discovery*, pp. 53–4.

61 D. Prain, 'A Sketch of the Life of Francis Hamilton (once Buchanan)', *Annals of the Royal Botanic Garden, Calcutta*, X (1905), p. lx.

dependent on what they took to be the highly unsystematic state of indigenous knowledge. In the course of his journey through Mysore in 1800, Buchanan noted with annoyance that villagers pretended to know the name of every plant, but actually used a limited repertoire of 'specific appellations', such as 'large', 'small', 'cultivated' and 'wild' to describe plants. Many names were thus given 'to the same species, and sometimes the same name to different species, with so little accuracy, that any person, who depends on their accounts will find himself thrown into great confusion'.[62] Robert Wight, another botanist of south India, had a similar experience, being given half a dozen different names for the same plant in the space of a few miles. He concluded that Indians had 'no means of producing an uniformity of name, and very frequently confound one name with another, so that our inserting these would only tend to mislead'. This posed a real danger when it came to identifying medicinal or poisonous plants.[63]

Although increasingly the testimony of nature was preferred to the testimony of 'natives', the rejection of local nomenclature was by no means absolute. As late as 1874 **Dietrich Brandis** urged forestry officers to learn Sanskrit and vernacular plant names, 'for in many instances they have a fixity which systematic names do not yet possess'.[64] But in general botanists favoured a tightening up of Indian taxonomy to bring it more closely into line with Europe. This was especially so when India's flora began to be studied by naturalists with no grounding in Indian languages. Hooker, who could never have assembled his vast collection of Himalayan plants without a small army of local assistants, warned against the proliferation of supposedly new species by giving indigenous names to what were in fact familiar plants. In its current 'backward state' Indian botany presented 'a perfect chaos of new names for well-known plants, and inaccurate or incomplete descriptions of new ones'.[65] In thus shedding its earlier Orientalist flirtation with Sanskrit and adhering more closely to European taxonomy, Indian plant nomenclature was indicative of a wider trend towards conformity in India's colonial science.

THE TRIGONOMETRICAL SURVEY

The Great Trigonometrical Survey of India has assumed an exemplary importance in the history of science under the Company. Susan Faye Cannon once

[62] Buchanan, *Journey*, 1, pp. 181–2.

[63] Robert Wight and G. A. Walker-Arnott, *Prodromus Florae Peninsulae Indiae Orientalis*, 1 (London, 1834), p. xxiv.

[64] Dietrich Brandis, *The Forest Flora of North-West and Central India* (London, 1874), p. xi.

[65] J. D. Hooker and Thomas Thomson, *Flora Indica*, 1 (London, 1855), pp. 36, 38.

remarked that, in seeking to establish the ideological imperatives behind British rule in India, the survey showed 'the workings of British policy better than still another study of Macaulay's education minute', adding that, as a scientific enterprise, 'it overshadowed all European geodetic operations'.[66] Surveying has served to illuminate the colonial power's ideological commitment to, and material motivation for, a sustained engagement with science on a grand (indeed subcontinental) scale, and to demonstrate the manner in which Western science in India might function more in response to local needs and conditions than at the behest of metropolitan science. With Michel Foucault in mind, the Indian surveys (and the accompanying exercises in map-making and topographical depiction) have been seen as constituting 'grids' of disciplinary knowledge, a means by which the British established a comprehensive network of surveillance and control over the Indian countryside. Matthew Edney has recently proposed (primarily in order to dispute that such a totalising project was ever in practice realisable) the idea of survey as a kind of scientific 'panopticon' designed to give the imperial power the capacity to 'see' and 'know' India in a systematic and scientific manner. Although he concludes, predictably, that the survey was a 'flawed geographic panopticon', we are none the less presented with the idea of the trigonometrical survey as standing at the forefront of British efforts to colonise India through science and technology and of scholars' attempts to establish the wider significance of colonial scientific and technological practices.[67]

Initially, surveying in India was closely bound up with a quest for dependable maps. European mapping of South Asia began in earnest with the French in the early and mid eighteenth century but advanced more rapidly after the English East India Company acquired Bengal and parts of southern India. Early map-making was primarily carried out through detailed, descriptive accounts of the features and topography of specific localities, as in the case of Mackenzie's survey of Mysore, or through military surveys taken along a line of march. These in turn provided the basis for regional maps of the kind that established James Rennell's cartographic reputation. Appointed India's first Surveyor-General in 1767, Rennell conducted a topographic survey of Bengal and Bihar, subsequently published as his *Bengal Atlas* of 1780, and in 1783 produced a *Map of Hindoostan*. But these techniques of map-mapping were notoriously haphazard, leaving blank large areas of the map away from the main routes and towns and even the distances between known points little more

[66] Susan Faye Cannon, *Science in Culture: The Early Victorian Period* (New York, 1978), p. 251.
[67] Edney, *Mapping*, pp. 24–5, 53–4, 325.

than conjecture. Astronomical observations provided a partial corrective, and were used by Topping and Goldingham at the Madras Observatory to calculate distances along the Coromandel coast, but this technique, too, was prone to error and difficult to use as a basis for systematic mapping over a wide area. More effective survey and mapping techniques were at this time being developed in Europe, of which triangulation was the most important. The British Trigonometrical Survey, dating from 1784, and the Irish Ordnance Survey provided important technical and organisational precedents for the trigonometrical survey and map-making in India; to this extent metropolitan precedents were clearly of great significance.[68]

Beginning in 1799, **William Lambton**, a British infantry officer, employed the new technique of triangulation, measuring out baselines with steel chains 100 feet long, to determine the distance between Madras and the west coast. Checked against astronomical readings, the survey, completed only in 1817, could then be used as a reliable basis for measuring and mapping south India. The perceived success of this technique prompted the founding of the Great Trigonometrical Survey in 1818, with Lambton in charge of its India-wide operations. Its task was to extend triangulation from the southern peninsula into central and northern India (through areas but recently wrested from Maratha control), thus providing a basis for mapping the entire country. By the time of Lambton's death in 1823 the survey had been carried as far as Berar in central India. Apart from the appeal to the state of its practical utility, the survey was seen by men like Lambton as being of immense scientific significance: British rule in India created a unique opportunity to measure a larger segment of the earth's surface than had hitherto been attempted anywhere else. The precise dimensions of the globe could thus be determined with unprecedented accuracy.

Under George Everest, Lambton's successor, the baselines were painstakingly re-measured with new equipment from Britain (the old measuring chains being replaced by 'Colby's compensation bars' to minimise variation in the length of the measuring instruments) and the line of triangulation was pushed northwards to the Himalayas. By the time Everest retired in 1843 a 'great meridional arc' had been measured by triangulation over 1,500 miles from Cape Comorin in the south to Dehra Dun at the foot of the Himalayas. With supplementary surveys (the Calcutta, Bombay and Karachi longitudinal series) linking eastern and western India, and with extensions into the northwest and Burma, the survey should, in theory, have provided an accurate basis by the

[68] Ibid., pp. 244–8, 288.

1860s for mapping the entire subcontinent. In technique, as in scale, the Indian survey was in advance of any geodetic survey undertaken at the time either in Europe or by other European powers overseas. Despite its British and Irish antecedents, and despite the extensive reliance on imported equipment, it reflected the initiative and determination of the Company's own military and scientific servants. It showed that colonial India was capable of generating its own techniques and institutions and was more than a mere camp-follower of metropolitan science. Despite Lambton's initial lack of support from the Madras government, it also demonstrated that the Company was capable (in this instance at least) of a sustained commitment to science, to the extent of making the survey in effect India's first dedicated scientific service.

Celebrated in science, the survey also served more immediately utilitarian ends. Surveying by land was a necessary adjunct to measures to determine the precise location of India's ports and coastal features and thus ensure greater security for the navy and maritime trade. As in Britain and France at the time, surveying operations reflected the close collaboration between cartography and the army, with its urgent need for maps that would reliably serve its needs in wartime. The Indian survey significantly originated under the auspices of an expansionist colonial state at a time of widespread warfare and political uncertainty in south and central India, and drew on the precedents of military engineers in Britain such as William Roy.[69] Both Mackenzie's topographical survey of Mysore and Lambton's trigonometrical survey of the peninsula arose directly out of the defeat of Tipu Sultan in 1799. Reliable maps were needed for military use and, even after the defeat of the Marathas in 1818, continuing resistance in Punjab and the perceived threat of Russian expansionism gave surveying a lasting military significance. Looked at in broader terms, the survey was a means of addressing what one member of the Governor-General's Council called the problem of 'the immense regions subject to . . . British authority or influence', in other words of how to transform India, with all its political and topographical diversity, into a single, mapped entity, an ordered and rationalised imperial space.[70]

And yet, for all its military and political importance in 'constructing' and 'disciplining' India, the survey, Edney has argued, never fulfilled its grand objectives. The 'cartographic anarchy' of the late eighteenth and early nineteenth centuries was only partly resolved by triangulation. The survey began

[69] Sven Widmalm, 'Accuracy, Rhetoric, and Technology: The Paris–Greenwich Triangulation, 1784–88', in Frängsmyr et al. (eds.), *Quantifying Spirit*, pp. 201–3.

[70] Matthew Henry Edney, 'Mapping and Empire: British Trigonometrical Surveys in India and the European Concept of Systematic Survey, 1799–1843', Ph.D. thesis, University of Wisconsin, Madison, 1990, p. 240.

only after much cartographic labour had already been expended, and its loosely constructed, Meccano-like skeleton was never sufficiently comprehensive to provide a basis for mapping the whole of India. Inconsistencies in Company policy, intra-provincial rivalries, the smallness of the survey establishment, the vulnerability of survey parties to ill health and accidents, the enormous cost and physical difficulty of surveying across India's rivers, mountains, deserts and jungles – all rendered a completely scientific survey an unrealisable goal. Edney sees this as calling into question the whole idea of the survey as a kind of omniscient, Foucauldian vision of empire, concluding that the 'apparent perfection of the geographical panopticon promised by the Great Trigonometrical Survey' was in the end 'an empiricist delusion'.[71] Even so, even if triangulation failed to deliver a comprehensive survey, it is striking how, under an often lackadaisical, cash-conscious Company, a vast scientific project was effectively sustained over several decades and with a conscious acknowledgement that it might serve ideological as much as practical objectives. Few other scientific enterprises, under Company or Crown, were ever so consistently favoured and supported.

There is a further point to be stressed about the survey. As with many other areas of early colonial science, it has rightly begun to be appreciated that mapping and surveying were heavily reliant on Indian skill and agency for their execution. Particular significance has attached to the career of Radhanath Sikdar, who worked for the survey from 1831 onwards, and the 'pandits' who after 1860 secretly carried surveying deep into Tibet, well beyond the reach of British surveyors.[72] But as Edney demonstrates, the technical and organisational precedents for the survey lay, not in India, but in the cadastral and topographical surveys developed in Europe since medieval times. Moreover, despite the genuinely appreciative remarks made by Europeans about individual survey workers such as Sikdar, within the survey as a whole Indians were strictly confined to subordinate posts. This was indicative of the manner in which such scientific endeavours and technological achievements were seen to reflect the superiority of Europe itself. 'By measuring the land,' Edney remarks, 'by imposing European science and rationality on the Indian landscape, the British distinguished themselves from the Indians: they did science, the Indians did not.' In form and function the survey articulated a British mastery over the Indian landscape, reducing the 'mystical, religious, Hindu space of India to a rational, scientific, imperial structure of space'.[73]

71 Edney, *Mapping*, p. 30.

72 Kumar, *Science*, p. 59; Kapil Raj, 'Les hommes – instruments de sa majesté', *Recherche*, no. 298 (1997), pp. 74–80.

73 Edney, 'Mapping', p. 19; *Mapping*, p. 32.

GEOLOGY

Although natural history and environmental sciences were among the main disciplinary sites of the Company period, some sciences found more favour than others. Despite significant descriptive accounts of snakes, fishes and birds, and pioneering work by Buchanan, Hodgson and Blyth, zoology was slow to establish itself as a distinct discipline in India, despite the wealth of material available. One reason for this was the lack of official interest and of an institutional base. Less obviously a 'useful' science than trigonometry or botany, zoology continued to reflect the passions of the amateur enthusiast, collector and hunter. T. C. Jerdon's *Mammals of India* in 1874 marked a move towards more a systematic study but, rather than invoke the material concerns of state and society, his manual was primarily intended for 'sportsmen and observers'.[74] *Shikar* (hunting) long remained one of Indian zoology's principal sources of inspiration and information.

Geology, by contrast, progressed rather more rapidly from amateurism to professional status and state support. Initially, as Andrew Grout has pointed out, geological investigation in India was slow to develop. One reason for this 'antipathetic attitude' was concern by the Company and influential pressure groups in London that India should not compete with Britain's own production of copper and other minerals. Another factor was a presumption that India was, and should remain, primarily a site for agricultural production, but a general ignorance of India's resources, an apparent lack of technical expertise and an exaggerated sense of the technological difficulties involved further discouraged systematic investigation before the 1830s.[75] Early accounts of mineralogy and stratigraphy were accordingly descriptive and sporadic. Reflecting on this in 1833, James Calder hoped that, just as Indian botany had 'found its Linnaeus' in Roxburgh, so 'we may yet see the treasures of the animal and mineral kingdoms unfolded to us by a Humboldt and a Cuvier'.[76] There was an inhibiting feeling, too, that India's geology had less to offer of scientific interest than its botany or zoology. As late as 1846 Captain Newbold extended to India Humboldt's observation that, whereas a host of new plant and animal species greeted visitors to the Americas, 'in the rocks we still recognise our old acquaintances; the same granite, the same gneiss, the same micaceous schists, quartz rocks, etc.'[77] The vast plains and deep alluvium of north India and

[74] T. C. Jerdon, *The Mammals of India* (London, 1874), p. v.

[75] Andrew Grout, 'Geology and India, 1775–1805: An Episode in Colonial Science', *SAR*, 10 (1990), pp. 1–18; Grout, 'Geology and India, 1770–1851'.

[76] James Calder, 'General Observations on the Geology of India', *AR*, 18 (1833), p. 1.

[77] T. J. Newbold, 'Summary of the Geology of Southern India', *JRAS*, 8 (1846), p. 156.

Bengal at first stirred little geological excitement and yielded few fossils. In remoter, less populated regions, 'impenetrable jungles' allowed only 'a vague and scanty knowledge' of underlying strata; wild animals and malaria added to the hazards of geological reconnaissance, as they did to those of surveying. Tigers, having 'no regard for science', would 'eat up a geologist as soon as they would any other animal'. Until canals and railways ran a scalpel through the landscape, there were few deep excavations to reveal rock strata and expose the fossil record. Compared with Europe, the geology of India appeared 'far less complex', even 'monotonous'.[78] Gradually, though, the distinctive features, the scientific opportunities and the practical rewards of Indian geology became apparent. The nature and origins of *kankar* (the calcareous nodules found extensively in north Indian soils) and laterite (first described by Buchanan in Malabar in 1800), the extraordinary depth of the alluvial deposits beneath Calcutta (revealed by boring for water to a depth of 500 feet), the vast extent and thickness of the Deccan lava flows (a feature, according to Newbold, 'not to be surpassed in any other portion of the globe'), the momentous discovery of the Siwalik fossils, and (in an age awakened to the 'sublime' quality of mountain scenery) the fascination of the 'stupendous' Himalayas had earned for Indian geology by mid-century international interest.[79] It was to this science, above all others, Larwood grudgingly conceded, that 'Indian field-workers contributed most significantly'.[80]

If, initially, geology reflected the individual enthusiasm of soldiers and surgeons rather than any official policy of mineral extraction, by the 1830s the Company was becoming more aware of geology's economic utility and new-found scientific standing. The arrival of steamships, with the prospect of railways to follow, made a search for coal imperative, and in 1836 a Committee for Investigating the Coal and Mineral Resources of India was duly created. The Industrial Revolution had formed a powerful image in British minds of the transforming power of coal and iron; coal was expected in India similarly to hasten the spread of 'European arts and improvements'. 'The history of coal', declared M'Clelland as Secretary to the Coal Committee, was 'sufficient to show how the manufactures of a nation may be improved by its judicious application, and there is no reason why its beneficial effect should be here less salutary than elsewhere'.[81] The committee sought to establish the location,

[78] Calder, 'Observations', pp. 6, 20; 'Geology of India', *CR*, 9 (1848), p. 327; R. Baird Smith, 'Notes Illustrative of the Geology of Southern India', *CJNH*, 1 (1840), p. 188.

[79] Buchanan, *Journey*, II, pp. 440–41; Calder, 'Observations', pp. 2–4, 17; R. Baird Smith, 'On the Structure of the Delta of the Ganges, as Exhibited by Boring Operations in Fort William, AD 1836–40', *CJNH*, 1 (1840), pp. 324–43; Newbold, 'Summary' (1846), p. 144.

[80] Larwood, 'Science', p. 71.

[81] *Reports of a Committee for Investigating the Coal and Mineral Resources of India* (Calcutta, 1838), pp. 16–17.

extent and accessibility of Indian coalfields, but its slow progress and lack of practical results illustrated the dilatory manner in which even such seemingly vital investigations often proceeded under the Company. 'The government move slowly in matters of improvement unconnected with the ordinary duty of government in judicial, revenue and political departments', a disheartened M'Clelland wrote to Lyell in 1844. 'Reforms in matters involving scientific questions such as the examination of the coal formations of India . . . stand every chance of being laid aside until forced upon its attention.'[82] In 1846, D. H. Williams of the British Geological Survey arrived to oversee the exploration of India's coal resources, but his death in 1848 brought further delay. The Court of Directors then sent out Thomas Oldham, former Director of the Geological Survey of Ireland, whose arrival in 1851 marked the birth of a more professional geological agency and, in the wake of coal, the beginning of a more systematic investigation of India's stratigraphy and mineralogy. Over the next fifteen years, as India embarked on its railway age, twenty-seven coalfields were investigated. Under the impetus of economic and technological change, geology shed its 'amateur' status to become an integral branch of the colonial administration. In this respect, the Geological Survey of India, like the Trigonometrical Survey, represented the emerging role of scientific and technological agencies in colonial state formation and in defining the expanding roles and responsibilities of the modern state in its Indian setting.

BOTANY

Utility was likewise the hallmark of colonial botany, but (like the Trigonometrical Survey) its significance extended beyond narrow instrumentality. Like geology, but from a much earlier date, Indian botany was seen both as having a practical utility and as being of interest to the international scientific community. A sound knowledge of Indian plants and their properties was an important asset to a Company that traded in spices, indigo and other natural products and whose European servants were constantly plagued with sickness. In 1778 the Danish surgeon-botanist J. G. Koenig, previously attached to the Tranquebar Mission, became the first naturalist formally employed by the East India Company. Though pioneering work on Indian flora had been carried out by the Portuguese physician Garcia d'Orta in Goa in the sixteenth century and by the Dutchman Heinrich Van Rheede in Malabar in the seventeenth, it was Koenig who introduced Linnaean taxonomy to India

[82] Sangwan, 'Reordering', p. 296.

and linked the study of Indian flora to the emerging global networks of botanical science. His work impressed the entrepreneurial Banks in London and paved the way for Roxburgh's research in south India.[83] Of all the sciences of Company India, botany was surely the least 'provincial' and the most closely embroiled with metropolitan science.

In Europe's 'age of improvement' botany was essential for the introduction of new plants to augment revenues from agriculture and trade and to protect populations from disease and famine. In India such objectives, for all their underlying commercial self-interest, lent themselves to representations of foreign rule in humanitarian guise and a judicious blend of profit and philanthropy was evident in the early history of India's botanic gardens. The first of these, at Calcutta, was established following a proposal in 1786 by Colonel Robert Kyd. Drawn more to utilitarian horticulture than to botanical science, Kyd urged that a garden be established for practical purposes and not for collecting rare plants 'as things of mere curiosity or furnishing articles for the gratification of luxury'. The introduction of exotics, like sago and date palms, would, he argued, supplement India's apparently meagre store of food plants and protect against the famines that had several times in recent decades devastated Bengal. (At about the same time in south India famine encouraged Roxburgh at Samalkot to think along similar lines: botany thus gave early warning of the importance famine was to hold for the entire development of science, technology and medicine in nineteenth-century India.) Kyd further suggested that, at a time of continuing conflict with Holland and France, the British would benefit commercially from having their own supply of cinnamon, still a monopoly of Dutch Ceylon, as well as indigo, cotton, tobacco, coffee and tea. The successful introduction and dissemination of such plants in Bengal would bring profit to the Company and enable the British to 'outstrip our rivals in every valuable production which nature has confined to this part of the globe'. The Court of Directors was sufficiently impressed by Kyd's economic arguments and the enthusiastic support given by Banks, an influential advocate for the contribution botany could make to trade and 'improvement', to sanction the proposal in 1787.[84]

With Kyd as its Honorary Superintendent, a horticultural garden was laid out at Sibpur, across the Hooghly from Calcutta, but by the time he died in 1793 the scheme had begun to flounder. The garden received a large number of plants from Southeast Asia and elsewhere, but many of the most important

[83] I. H. Burkhill, *Chapters on the History of Botany in India* (Delhi, 1965), pp. 4–20.

[84] Kalipada Biswas, *The Original Correspondence of Sir Joseph Banks Relating to the Foundation of the Royal Botanic Gardens* (Calcutta, 1950), pp. 3–12; Gascoigne, *Banks*, pp. 185–236.

introductions, including tea bushes from China, failed to thrive in Calcutta's heat and humidity. Under Roxburgh, Kyd's successor, the utilitarian engagement with economic botany was retained and extended (as through Roxburgh's investigation of vegetable fibres), but the gardens became more a centre for plant collection and classification than Kyd had intended and the practical improvement of Indian agriculture remained a relatively neglected item on the agenda of Company science. Roxburgh confined himself to a 'quiet life in the Calcutta garden', where he classified over 2,000 species, leaving to Buchanan and Wallich the 'restless life' of plant collection in Nepal, Assam and Burma, before they in turn took charge of the gardens after Roxburgh's departure in 1813.[85]

Though much the most famous, Calcutta was not India's only botanic garden. By the 1850s there were several such gardens distributed throughout India; one of the most important of these was established at Saharanpur, on the southern fringes of the Himalayas. In 1817 Surgeon George Govan proposed Saharanpur as a suitable location for growing plants that would not thrive in Calcutta.[86] Govan left in 1821, but over the following decades the 40 acre garden flourished and the sale of plants from Saharanpur, including many of the trees that lined the banks of the north Indian canal system, yielded a modest income. As the garden's Superintendent from 1823 to 1831, J. Forbes Royle, investigated the properties and commercial potential of cotton, tobacco and other 'useful plants'; tea was successfully introduced, but cinchona failed. He tried to impress on the Company the vast range of India's vegetable products and their value alike for 'the comforts of the people' and 'the wants of a great empire'.[87] Royle, who continued to stress the commercial value of India's economic botany after retiring to London, was (like many other surgeon-naturalists) well aware how much science depended on the Company's favour, but also how sluggish it could be even where agricultural improvement was concerned.

Botany also illustrates some of colonial science's other roles. In the 1790s the Baptist missionary William Carey laid out a 5 acre garden and herbarium at Serampore, north of Calcutta, in which he tried to grow, among other plants, the hedgerow flowers that reminded him of his native Northamptonshire. There was more to this than homesick sentimentality. Botany, for Carey, as for many Christian naturalists of his day, was a celebration of God's handiwork,

[85] Burkhill, *Chapters*, p. 28.

[86] H. Montgomery Hyde, 'Dr George Govan and the Saharanpur Botanical Gardens', *JRAS*, 49 (1962), pp. 47–57.

[87] J. Forbes Royle, *Illustrations of the Botany and Other Branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere*, 1 (London, 1839), p. 442.

and when he edited his friend Roxburgh's *Flora Indica* for publication, the title page duly bore the inscription: 'All Thy Works Praise Thee, O Lord.' Carey, like Kyd, also valued the practical, 'improving' side of botany and he was largely instrumental in setting up the Agricultural Society of Calcutta in 1820.[88] There is no doubt, too, that Company servants derived aesthetic pleasure from the study of Indian flora and from the coloured plates and drawings that adorned their botanical works. Botany was an art form as much as a science, especially at the hands of illustrators like Vishnu Prasad and Laksman Singh, whose paintings for Hodgson, Wallich and Royle were both a necessary means of preserving and disseminating plant data and a means of utilising the decorative skills of Indian artists.

A further aspect of botany was its intimate relationship with medicine. The science of botany had emerged in medieval and early modern Europe hand-in-hand with medicine; the identification of medicinal plants and a knowledge of their properties long remained an essential part of medical training. Although in Europe botany had achieved a degree of intellectual independence from medicine by the mid-eighteenth century, it still formed an integral part of the education of Company surgeons, especially those trained at Edinburgh University – Roxburgh, Buchanan and Falconer among them. Of the forty-two individuals I. H. Burkhill identified as practising botanists in the period up to 1840, twenty-eight were surgeons, as were roughly a quarter of those active in the second half of the century.[89] That surgeons enjoyed a comparable ascendancy in zoology, and to an almost equal extent in early Indian geology and forestry, made the Company's medical service, in effect, an all-purpose scientific agency and for a long time obviated the need for other, more specialist, bodies. Not until 1890 did India have a Botanical Survey, or till 1916 an equivalent organisation for zoology.

In India the close association between botany and medicine was strengthened by the cost-driven search for local substitutes for imported drugs and the need to know the names and properties of plant medicines used by Indian physicians.[90] Like astronomy, this could constitute a significant link with indigenous knowledge, but it could be a critical as well as appreciative engagement. At Saharanpur, Royle, responsible for the medical needs of a large military station as well as for the botanic garden, investigated items of materia medica sold in local bazaars and speculated on the relationship between Indian medicine and that of the Middle East and Europe. Ultimately, he

[88] F. Deaville Walker, *William Carey: Missionary Pioneer and Statesman* (London, 1926), pp. 302–5; O. P. Jaggi, *Science in Modern India* (Delhi, 1984), pp. 38–9.

[89] Burkhill, *Chapters*, pp. 27, 272.

[90] John Fleming, 'A Catalogue of Indian Medicinal Plants and Drugs', *AR*, 11 (1810), pp. 153–96.

reversed his original assumptions about the Graeco-Arabian origins of Indian pharmacology and, in a seminal piece of Orientalist reasoning, concluded that the Indian medical system was much older.[91] In pursuit of his botanical and medical interests, Royle enlisted the help of merchants who travelled to Kashmir to bring back seeds and plants for him, some of which he successfully propagated at Saharanpur. Many of the plants investigated were of medicinal value and Royle sought to determine which plants Indian physicians used and to describe scientifically the nature and properties of each species; the results were published in his study of Himalayan flora in 1839. Since Hindu pharmacology was 'noted for the employment of powerful drugs' – such as aconite, nux vomica and croton – it was essential to know which plant was which, which parts of a plant should be used and for which purpose, and to standardise the taxonomy of medicinal plants across India as a whole.[92] On leaving India, Royle returned to London where he was Professor of Materia Medica at King's College from 1837 to 1856. Like Falconer, Royle was one of several Company surgeons who subsequently established scientific or academic careers in Britain, and who, while maintaining an interest in India, made significant contributions to metropolitan science.

SCIENCE IN THE TROPICS

At a time when Orientalist scholarship was examining the connections between the languages, literatures and religions of India and Europe, the sciences of the period were engaged in the parallel exercise of situating India relative to the rest of the natural world. In part this was an exploration of universality, fitting information about Indian stratigraphy or ornithology into an emerging global picture of the fossil record and geological epochs or of avian species and their distribution. At the same time, however, and with growing force, the scientists of the Company period were turning away from indigenous knowledge and addressing themselves directly to the forms and properties of India's natural history and physical environment. In so doing they were investigating not only those aspects of nature that linked India to the more familiar scientific domain of Europe but also those that appeared to differentiate India, as an essentially 'tropical' country, from more temperate lands. This investigation established tropicality as one of the central paradigms of colonial science in India (and India, equally, as one of the primary sites for the investigation of tropical plants, animals and diseases). At the same time it

91 J. F. Royle, *An Essay on the Antiquity of Hindoo Medicine* (London, 1837).
92 Royle, *Illustrations*, I, pp. 47–8.

gave emphasis to the external, judgemental nature of colonial science and the manner in which science informed colonial attitudes to Indian society and culture.

The Western identification of tropical, as opposed to temperate, regions of the globe has a long history. It can be traced back to the early European voyages of exploration, but it was strengthened in the seventeenth and eighteenth centuries by the apparent failure of white settlement in the West Indies and the lowlands of the tropical American mainland. The conviction grew that such regions were unsuited by climate and disease for European settlement and agriculture and better fitted for African slavery and plantation crops. By the mid-eighteenth century, as European rivalries intensified, an extensive literature in natural history, in topography and, above all, in medicine emerged, depicting the West Indies as a hazardous environment for peoples from the temperate lands of Europe. From this cardinal site, ideas of tropical 'otherness' circulated around the globe. At first India did not seem to fit readily within this emerging temperate/tropical paradigm. From at least the time of the famine in Bengal in 1770, with its estimated 10 million deaths, India was seen as a land of recurrent dearth and disease, an image that was sustained and intensified by the widespread famines and epidemic mortality of the nineteenth century, especially after 1860.[93] India's droughts and famines seemed to contradict the general perception of tropical fertility and natural abundance that, Malabar and Assam apart, seemed more appropriate for Sri Lanka and the Malayan archipelago than for India. Nevertheless, by the 1820s and 1830s the word 'tropical' was coming into increasingly common use in botanical, medical and even geological texts in India as a more positive evaluation of Indian civilisation began to recede and to be replaced by a heightened sense of Indian vulnerability to an often cruel and capricious world of nature.[94] The creation of India's botanic gardens and their connection with famine is indicative of the extent to which the population of India appeared unable to sustain, unaided, adequate levels of subsistence: hence the perceived need for European scientific knowledge and technological expertise to redeem them from their servitude.

These negative representations of India mingled, somewhat paradoxically, with growing commercial and botanical interest in the value to Europe of India's tropical agriculture. At about the time Kyd was proposing a botanic

[93] For the principal famines of the period, see Leela Visaria and Pravin Visaria in Dharma Kumar (ed.), *The Cambridge Economic History of India, II, c.1757– c.1970* (Cambridge, 1983), pp. 528–31.

[94] David Arnold, 'India's Place in the Tropical World, 1770–1930', *Journal of Imperial and Commonwealth History*, 26 (1998), pp. 1–21.

garden for Calcutta, Banks, as President of the Royal Society and scientific adviser to the East India Company in London, was urging the Court of Directors to develop its newly acquired Indian territories as a tropical dependency. Banks proposed the introduction or expansion of crops such as sugar, cotton, coffee, cochineal and indigo, which could not be grown in Europe but were of great value and importance to British trade and manufacturing. The size of India, the diversity of its products, the variety of its climates and soils, the abundance of its labour – all made India appear an ideal but under-utilised estate that could serve and complement British agriculture and industry. In this role, Banks believed, India would soon outstrip the West Indies.[95] In 1788 he presciently observed that the country between Bengal and Bhutan might be ideally suited for the cultivation of tea. This was a region, he added in one of the first references to India's tropicality, where 'in a few days you get from the tropical heats and consequently tropical productions to a climate similar to that of Europe'.[96]

Along with medicine, botany was one of the principal channels through which the concept of a tropical India became established in colonial discourse. As early as 1829 the Agricultural Society of Calcutta saw one of its principal aims as being to introduce plants 'from other tropical countries, especially America and the West Indies'.[97] At the Saharanpur garden, Royle took up a similar task. Like many of his contemporaries, he greatly admired the work of the German naturalist Alexander von Humboldt, and made frequent reference to 'the illustrious Humboldt' in his account of Himalayan flora. In fact, Royle was in many respects a poor representative of 'Humboldtian science'.[98] He lacked the German's pioneering use of scientific instruments, measurement and mapping, and could not match his Romantic enthusiasm for the aesthetic delights and spiritual experience of landscape and vegetation. He was also less of a traveller: most of Royle's knowledge of the Himalayan region was remarkably secondhand. But Humboldt's descriptions of South America enthused Royle to see an analogy between the effects of elevation and aspect on the climate and botany of the Andes and those of the Himalayas, and he developed the idea of India having tropical, temperate and alpine zones as a matter of great practical significance. If Calcutta's botanic garden gave institutional form to the India of the tropics and illustrated the kinds of plants that might

[95] David Mackay, *In the Wake of Cook: Exploration, Science and Empire, 1780–1801* (London, 1985), pp. 174–6. [96] Harold B. Carter, *Sir Joseph Banks, 1743–1820* (London, 1988), p. 272.

[97] *Gleanings*, 1 (1829), p. 208.

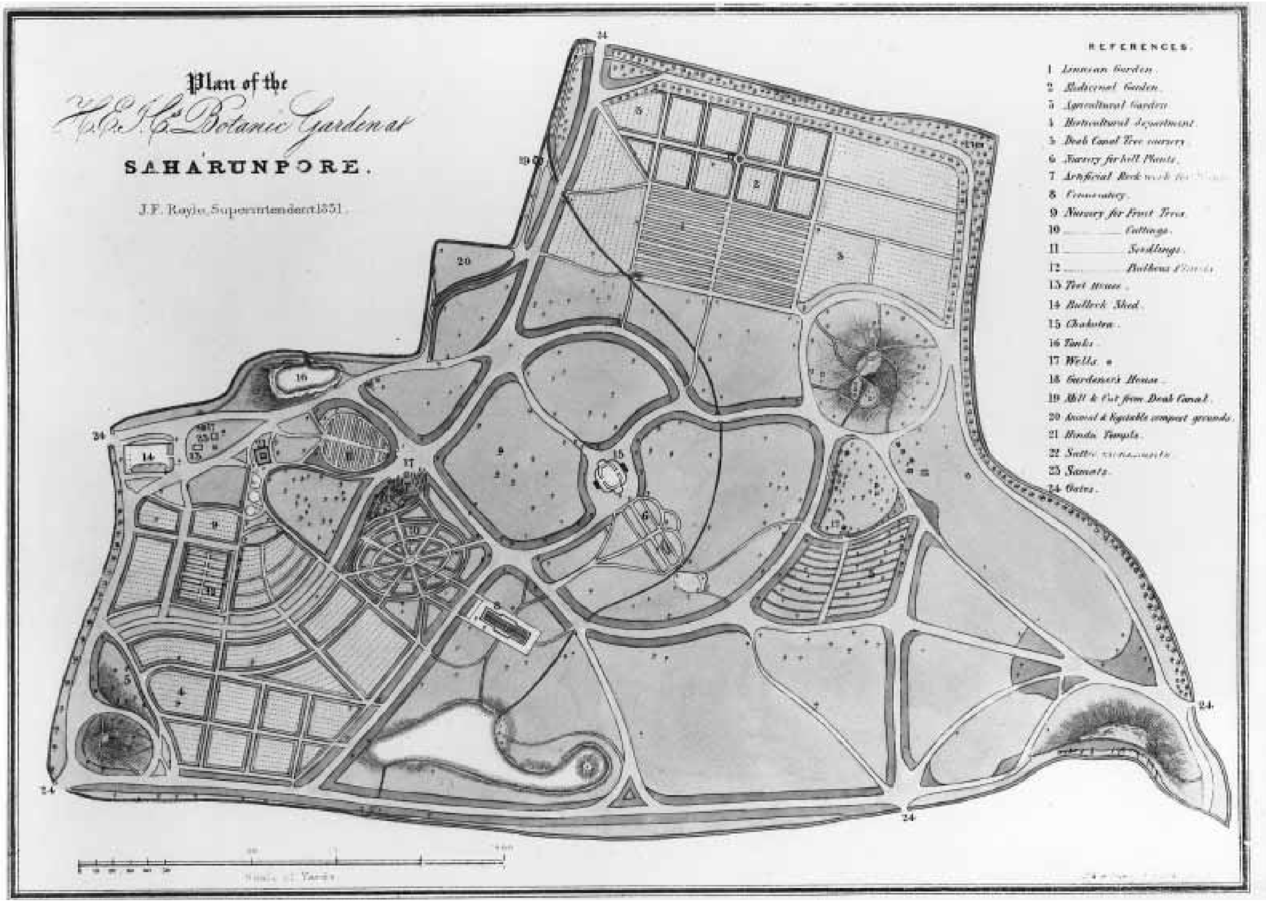
[98] Cannon, *Science*, pp. 73–110; Malcolm Nicolson, 'Alexander von Humboldt and the Geography of Vegetation', in Andrew Cunningham and Nicholas Jardine (eds.), *Romanticism and the Sciences* (Cambridge, 1990), pp. 169–85.

be imported and naturalised from tropical America, Africa and Southeast Asia, so, at 1,000 feet above sea level and lying at the foot of the Himalayas, Saharanpur represented a temperate environment. Some tropical plants might be grown there, but the higher one moved into the foothills and valleys of the Himalayas the more one passed, as in the Andes, from tropical to temperate, and ultimately to alpine, vegetation. There was accordingly hardly any 'useful' plant – tropical or temperate – that could not be grown somewhere in India.

The growing perceptual division between tropical and temperate South Asia was accentuated by the fact that early nineteenth-century botanists were interested in the exuberance and diversity of tropical plant life – as in northeastern India and Malabar – or in the temperate species of the Himalayas and Nilgiris, but found little of interest in the cultivated plains in between. For Royle, as for many of his contemporaries, the Himalayas held a special fascination that elided science with sentiment. Just as the mountain range appeared as a bridge between the languages and races of southern Asia and Europe, so was it the magical trysting place where the fauna and flora of Europe and western Asia joined company with those of Southeast Asia and China. After the alien, torrid plains, the Himalayas represented to naturalists, as to many other Europeans, a kind of spiritual homecoming. Royle explained that, on arriving 'in a tropical country' like India, a European was first struck by 'the magnificent peculiarities of its vegetation'. But after an extended residence these pleasures palled; his attention was 'more quickly excited by the re-appearance of forms with which he was familiar in his youth, and which characterise the more humble and verdant, but not less beautiful flora of temperate climates'. The higher one climbed in the Himalayas, the more 'the plants of India disappear, and we are delighted at finding the increase in number and variety of those belonging to the European genera'. At first there were 'only a few struggling towards the plains, which in a more temperate climate would be their favourite resort', and it was 'not until we have attained a considerable elevation that, having apparently lost all traces of tropical vegetation, we enter a forest of pines or oaks, and lofty rhododendrons, where none but European forms are recognisable'.[99]

The scientific representation of India in terms of a torrid core and temperate rim received authoritative endorsement from Hooker in the 1840s. Following his earlier travels in Antarctica and New Zealand, Hooker was eager to acquire a corresponding knowledge of the tropics. India initially disappointed him: the vegetation of Bengal was not tropical enough for his Humboldtian fervour, and only when he travelled up into the Himalayan

[99] Royle, *Illustrations*, I, p. 15.



Plan of the H.E.I.C.'s Botanic Garden, Saharunpore, 1831, from J. Forbes Royle, *Illustrations of the Botany and Other Branches of the Natural History of the Himalayan Mountains and of the Flora of Cashmere*, II, London, 1839, map between plates 10 and 11; Wellcome Institute Library, London foothills did he begin to find the kind of 'tropical luxuriance' he had anticipated, but he was even more enthused by the temperate flora that lay higher up. The violets, strawberries, oaks and birches 'vividly' recalled England: some flowers were 'so notoriously the harbingers of a European spring that their presence carries one home at once'. Hooker declared Darjeeling an ideal site for a sanatorium, a place where European children, brought up 'sickly, pallid or yellow' from the plains, were swiftly transformed into 'models of rude health and activity'.[100] In what might be taken as a precedent for the subsequent location of scientific research institutes in Indian hill-stations, Hooker then settled down with his host, Hodgson, to study India's natural history from his Himalayan eyrie.

Orientalist scholarship and a tropical/temperate paradigm of environment and natural history were not necessarily irreconcilable pursuits; in many ways they formed part of the same exploratory, utilitarian, integrationist agenda. Jones, the Orientalist, and Banks, the economic botanist, shared much in common in their attitudes to empire and 'improvement'. Without much grounding in Sanskrit, Royle could produce a seminal text establishing the antiquity of 'Hindoo medicine'; he could also, as surgeon-botanist, extol the virtues of developing India's temperate as well as tropical agriculture. With its *sati* monuments, Chinese tea bushes and Linnaean garden, laid out on the site of what had once been a Rohilla chief's pleasure garden, Saharanpur was itself suggestive of the eclecticism of Company science. But, increasingly, the pursuit of botany, like geology and zoology, led science to depart further and further from Sanskrit texts and Brahmin pandits, and brought it instead into closer association with the land forms, natural history and human inhabitants of the remoter parts of India. While the Company's own relationship with science remained, at best, equivocal, Western science, as part of the cultural world-view of the colonial elite, increasingly framed the British understanding of India, juxtaposing, as in the case of Awadh on the eve of its annexation, the enticing potentialities of vast natural resources with the glaring deficiencies of

[100] Joseph Dalton Hooker, *Himalayan Journals*, I (London, 1854), pp. 109, 120.

1 Linnean Garden.	9 Nursery for Fruit Trees.	17 Wells.
2 Medicinal Garden.	10 .... Cuttings.	18 Gardener's House.
3 Agricultural Garden.	11 .... Seedlings.	19 Mill & Cut from Doab Canal.
4 Horticultural department.	12 .... Bulbous Plants.	20 Animal and vegetable compost grounds.
5 Doab Canal Tree nursery.	13 Tool House.	21 Hindu Temple.
6 Nursery for hill Plants.	14 Bullock Shed.	22 Suttee monuments.
7 Artificial Rock work for Plants.	15 Chabutra.	23 Samats.
8 Conservatory.	16 Tanks.	24 Gates.

its weak and decadent rulers.[101] Where Jones and the early Orientalists had seen India as an ancient, if decayed, civilisation, worthy of comparison with Greece and Rome, scientists of a later generation turned instead to independent observation of the natural world, or pondered the tyranny with which nature ruled the lives of races bereft of modern science and technology. It was increasingly axiomatic that without them there could be no durable civilisation, no lasting 'improvement', in the tropics.

[101] 'The Physical Capabilities of Oude', *CR*, 24 (1856), pp. 415–44.