Science in Context **18**(3), 359–392 (2005). Copyright © Cambridge University Press
doi:10.1017/S026988970500058X Printed in the United Kingdom

"Eyes and No Eyes": Siwalik Fossil Collecting and the Crafting of Indian Palaeontology (1830–1847)

Savithri Preetha Nair

School of Oriental and African Studies, University of London

Argument

The context of discovery and collection of Siwalik fossils had far less to do with science than with the ability to effect "translations" that helped bring together a wide range of social worlds, from the Doab Canal engineers working at the foot of the Hills, surgeon-botanists at the Saharanpur Botanic Gardens, other colonial officials, the native "Hindoo" diggers and collectors, to all of whom the Siwalik Hills was a "boundary object," a common factor that bound their lives together. In this colonial scientific collecting episode pertaining to the discovery of a new field of research, cooperation between different participants is achieved not by using methods of standardization but through an emphasis on greater heterogeneity, both in terms of the "allies" enrolled and fossils collected. Heterogeneity becomes a factor of strength rather than a weakness that deters the practice of science. This essay employs sociological reflection to examine the context of discovery, collection, and justification of a significant group of fossils in India in the 1830s–40s.

Introduction

In 1837, two colonial officials, Captain Proby Cautley (1802–71), an irrigation expert of the Bengal engineers, and Dr. Hugh Falconer (1808–65), a surgeon-botanist of the Bengal medical establishment, were jointly awarded the Wollaston medal of the Geological Society of London for their palaeontological discoveries in the Siwalik Hills, near the town of Saharanpur in Northern India. Charles Lyell announcing the award, remarked on how the duo had overcome the disadvantages of "being stationed on the remote confines of our Indian possessions," distant from "any living authorities or books on Comparative Anatomy" to discover and examine the remains (Murchison 1868, vol. 1, xxx). Regarded as the greatest "find" of the times, moves to acquire Cautley's private collection for the national collection in London began soon after, and in 1841 it reached the British Museum's mineralogy department for exhibition and science. This article examines the socio-historical context of the discovery and collecting of Siwalik fossils and how it influenced the shaping of Indian palaeontology in the 1830s–40s.

The making of science, particularly field sciences such as geology, is essentially heterogeneous in nature and involves the cooperation of a wide range of social worlds including a great number of non-scientists or amateurs (Porter 1978; Rudwick 1985; Secord 1994; Knell 2000). Rather than being driven by theory, science is based on the ability to craft knowledge from practical solutions to the everyday problems encountered during field work (Gooding et al. 1989; Fujimura 1992). Historians have demonstrated how practice of science in the field is open to participants from any social world quite unlike practice in enclosed spaces such as laboratories, which are relatively speaking, exclusive and inhabited invariably by people with special training (Kuklick and Kohler 1996). Objects like plants, animals, fossils, and meteorites collected from the field are attributed different meanings by the various social groups that come into contact with them, thus putting them to different uses. Coordination between these differing beliefs and actions plays an important role in how science is crafted. Exploring the culture of geology, both from within the world of science and without through an examination of the culture of fossil collecting in early nineteenth-century England, Knell demonstrates how geology is fundamentally a collecting science. Fossils connected social worlds as distant as the aristocrat and the laborer, and meant many things to many people. Knell however is quick to point out that it is not enough to speak of these differing beliefs regarding fossils, for if the study of fossils is to contribute to science we must first unravel the processes of their collecting and exchange.

Heterogeneity and cooperation are also the main issues for Star and Griesemer (1989) who examine the historical development of Berkeley's Museum of Vertebrate Zoology. Drawing from the "sociology of translation" put forth by Callon and Latour, they identify two major factors contributing to the success of the natural history research museum, namely methods of standardization and "boundary objects." Cooperation between heterogeneous social worlds is attained through a process called "translation," wherein scientific authorities or entrepreneurs enlist or enroll "allies" and reinterpret their concerns in such a way as to become "obligatory passage points." "Translation" involves the making of equivalences between objects that might have seemed very different previously (Latour 1987; Callon [1986] [1998] 1999, 69–81). Star and Griesemer however object to the argument that the concerns of a wide range of actors ultimately "funnel" into a narrow "obligatory passage point." Instead they argue that several "passage points" negotiate at any given time with several kinds of "allies" producing multiple sets of "translation." One of the ways, they argue, of achieving a successful "translation" is through the creation of "boundary objects." These objects refer to entities, abstract or concrete, which connect social worlds, despite the differences in meaning ascribed to them. Rather than differences, it is the shared beliefs that become more important (Star and Griesemer 1989). The authors demonstrate that it is not simple consensus, nor the operation of a single "obligatory passage point" that ensures stability but the "trading of objects across boundaries between different social realms" (Golinski 1998, 43–44).

Field sciences like botany, zoology, geology, astronomy, meteorology, and anthropology, which have been shaped by colonial connections, present an even more complex picture.[1] However, studies that examine the heterogeneity of scientific practice and how it incorporates the material world into human life have invariably chosen case-studies from within the Western context with the notable exceptions of Soojung-Kim Pang (2002), who examines Victorian eclipse expeditions in the colonies and the social forces that shaped astronomy, and Schumaker (1996), who examines the social networks that shaped cultural knowledge in Central Africa. This article employs sociological reflection to examine the context of discovery, collection, and justification in the 1830s–40s of a significant group of fossils in India. The narrative, which begins in the colonial field, ends in the metropolitan museum and is historically situated between a collecting phase that ended in 1820 with Joseph Banks' death and one that began in the late 1840s and eventually led to the establishment of the first public museums in India.[2] During the intervening period, the premier scientific society of India, the Asiatic Society of Bengal began to be particularly active when James Prinsep (1799–1840), Chief Assay-Master at the Calcutta Mint, was appointed Secretary of the Society's Physical Class, a branch entirely devoted to science.[3]

The context of discovery and collection of Siwalik fossils had far less to do with science than with the ability to effect "translations" that helped bring together a range of social worlds, from the Doab Canal engineers working at the foot of the Hills, surgeon-botanists at the Saharanpur Botanic Gardens, colonial officials like Collectors and Magistrates, and the native "Hindoo" diggers and collectors, for all of whom the Siwalik Hills was a "boundary object," a common factor that bound their lives together. Called "Bijili ki har" (or "lightning bones"), fossils in the Himalayas had been discovered even earlier by colonial travelers. These were collected by natives and exported to the plains as magical charms and by this route had reached H. T. Colebrooke, the President of the Asiatic Society of Bengal who dispatched the same to Europe. The next notice of fossil discovery in India was from John Crawfurd, who in 1826 during the embassy to Ava (Burma) discovered a deposit of silicified bones of large animals on the banks of the Irrawadi. William Clift's description of some of the identifiable animals in the *Geological Transactions* caused great excitement in England as the existence of two fossil species of the Mastodon specific to India had come to light. The inability to distinguish a fossil from a mineral in extreme cases of petrifaction led to their being abandoned or destroyed. On one occasion, Sepoys broke up a fossilized elephant tusk and burnt it for "pipeclay to whiten their belts" (Murchison 1868, vol. 1, 641) and on many other occasions, fossils were simply thrown back into the rivers.

[1] For studies that examine the field sciences such as botany and geology from within the imperial context, see Brockway 1979; Sangwan 1991; Deepak Kumar 1995; Grove 1995; and Drayton 2000. However, none of these studies examine collecting processes and their impact on the shaping of science.

[2] Joseph Banks (1743–1820), the President of the Royal Society, functioned as a "center of calculation" directing a network of colonial naturalists who collected natural historical specimens for him between 1770 and 1820 (Miller 1996).

[3] For an institutional history of the Asiatic Society of Bengal, see Kejriwal 1998. Also see Asiatic Society of Bengal, Centenary Volume (1885).

The scientific significance of the Siwalik formation must be understood in the light of the vast intellectual influence wielded by the work of the French anatomist and geologist Georges Cuvier (1769–1832) during these times both in England and the continent.[4] In his 1796 paper entitled "On the species of living and fossil elephants," Cuvier demonstrated with irrefutable evidence the reality of extinction for the first time ever (Rudwick 1976, 101–57). To explain extinction Cuvier put forth the "catastrophic theory of the earth," which explained extinction as caused by a deluge or a "revolution" of the earth which was prolonged and localized in its effect. His research over the next couple of decades further revealed that a whole fauna had disappeared from the face of the earth and not just the Mammoth or the *Megatherium* ("Big Beast"). He analyzed each bone in functional terms, in relation to the rest of the body, but this alone was not enough as only by studying living animals could one establish their zoological identity. With assistance from fellow catastrophist, Brongniart, Cuvier elegantly demonstrated his "rational principle" of comparative osteology by reconstructing Marsupials, the *Paleotherium* (ancient beast), Anoplotherium and the Mastodon, creating "a spectacular zoo" of extinct animals from the many mammal remains they discovered together in the tertiary beds of the gypsum quarries of Montmartre in France. By 1830, the "spectacular success of some three decades of research on fossils had transformed Cuvier's early demonstration of a single recent organic revolution into a palaeontological synthesis of very wide scope and explanatory power."

"Methods of standardization," which Star and Griesemer speak of as one of the ways by which "translation" is effected in the context of the development of a research museum, are not strictly applicable to the discovery of a new field of research as there exists no vision of what must be collected. The discovery of fossils was not a momentous happening, but an act that stretched itself over a period of time. Discovery and collecting went hand-in-hand in the case of fossils, instead of the latter being a consequence of the former, as every fossil fragment discovered was unique, unlike the collection of extant plants and animals, of which more of the same kind was often available. It may seem ironical, but cooperation in such a situation is achieved not by disciplining participants and standardizing methods of collection but by emphasizing greater heterogeneity or extensiveness, both in terms of the "allies" enrolled and the fossils collected. Heterogeneity here becomes a factor of strength rather than a weakness that deters the practice of science.

[4] William Buckland, Reader in Geology at Oxford was best known for his popular and entertaining lectures which made the diluvial theory very influential among English geologists. However, his diluvial interpretation involved drastic scientific modifications of Cuvier's theory in that he believed the deluge to be transitory and universal rather than prolonged and localized. In 1821, Buckland had discovered a cave in Yorkshire with a rich deposit of bones of extinct species. Using Cuvier's comparative osteological method he reconstructed the extinct species and studied the habits of the Hyena in the Exeter zoo to prove that the bones had been gnawed by Hyenas. This implied that the most recent revolution had not "been an interchange in the positions of continents and oceans, as Cuvier had suggested, but a more transitory event that had left the present continents where they were." This discovery won him the Royal Society's Copley medal (see Rudwick 1979, 135).

We also aim to demonstrate how an original "obligatory passage point" can give birth to other "passage points" until multiple "passage points" are found negotiating simultaneously with "allies" towards achieving not only the original goal but also newly invented ones. At some point, the center of interest can completely shift from the original "passage point" to another that has newly formed through the collusion of two strong "allies" who invent a new goal, or between one strong ally and a scientific authority who can work out a partnership on the basis of a strict division of labor, as in the case of Cautley and Falconer. Though they held different visions about the use of fossils for science, through a "trading zone" that connected them, they succeeded in achieving their shared goal of building up an almost complete series of Siwalik fossils, which eventually won them recognition from the world of metropolitan science. A "trading zone" is a "social and intellectual mortar" that can bind two social worlds despite the radically different significance they attribute to the object concerned (Galison [1997] [1998] 1999, 146). The small native hill State of Nahun and the colonial State represented by the Governor General of India were connected by such a "trading zone," which enabled the collection of Siwalik fossils despite the differing beliefs with respect to fossils.

If usual episodes of discovery narrate disputes arising from conflicting or competing claims, here in this fossil episode we have an example of how invoking "original discoverers," even if they belonged to a period way back in time and had no idea of the scientific significance of their discoveries, was used as a strategic method to achieve the desired goal. This article is also about "heterotopic" men of science, the transgressors such as surgeon-botanist Falconer, who could easily cut across spaces or boundaries of disciplines, of colonial and metropolitan science, of cultures, of theory and practice, and of the "field" and the "museum." The influence of the collecting processes on the shaping of science is best reflected in Falconer's invention of a zoological nomenclature of Siwalik fossil zoology, the crafting of a fossil monument, the *Colossochelys Atlas*, lobbying for metropolitan funding and his "antiquarian" palaeontology that drew on inspiration from local Hindu mythology.

The intention here is to map all the observable practices concerned with the discovery and collection of Siwalik fossils in the colonial field, their transportation to London, communication of the discoveries in the metropolis, exhibition and reproduction at the British Museum and the publication of the first catalogue of the fossil specimens, without narrating the story from the viewpoint of any one actor.

Discovery and Collection: The Siwalik Hills as "Boundary Object"

Just when John Crawfurd's discovery of the Ava fossils had begun to recede in the minds of metropolitan geologists, a new field of fossil discovery, of immense significance to vertebrate palaeontology, was thrown open to the world quite fortuitously by the colonial engineers working on the Doab Canal.[5] The Canal was an old channel of irrigation drawn from the left bank of the Jumna at the foot of an uninterrupted chain of hills between the Sutlej and the Brahmaputra rivers called the Siwaliks.[6] The government had ordered the removal of obstructions in the river Jumna in 1828 and while engaged in excavation work, engineer Cautley accidentally discovered coal and lignite in the nearby Siwalik hills; the lignite agreed to all descriptions of it with the exception of marine or organic remains (*Asiatic Researches* 1828). The discovery was promptly brought to public notice by James Prinsep, who by being secretary of the Physical Class of the Asiatic Society at this time was one of the most influential figures shaping science in the colony.

At about the same time, a Scottish surgeon, Hugh Falconer was preparing to travel to India to take up the post of assistant surgeon in the company's Bengal establishment. After spending almost a year assisting naturalist Nathaniel Wallich in sorting out the latter's rich Indian herbarium, Falconer studied geology, particularly "Indian fossils" under William Lonsdale at the Geological Society's Museum in London. He was thus in a position to publish an account of the Ava fossil bones in the Asiatic Society's Museum soon after his arrival in Calcutta in 1831, even before he was appointed deputy to Wallich's successor, John Forbes Royle, the superintendent of the Botanic Gardens in Saharanpur (*Gleanings in Science* 1831, 1:167–68).[7] Situated at close proximity to the Gardens was the largely unexplored Siwalik Hills. Cautley's account of the presence of lignite in the region had triggered Falconer's curiosity so much that he had begun to explore the hills, sometimes in the company of Royle, to study its geological structure (see fig. 1).

To his great excitement he found these sub-Himalayan ranges to be analogous to the Molasse of the Alps, "equivalent in age to the oldest of the tertiary series of English formations, or plastic clay, together with the London and Paris basons" and abounding in not only lignite but also "noble fossils of the monsters of the deep!" (*Journal of the Asiatic Society of Bengal* (hereafter *JASB*), March 1832, 1:97). Tertiary strata at such an elevation had never before been discovered in this part of the world. Receiving intelligence of Falconer's discovery, Prinsep was instantly drawn to the possibility of establishing a geological link between the Siwaliks and that of Ava on the banks of the Irawadi, "so productive in magnificent specimens of organic reliquiae." Falconer however chose to remain silent on the subject being wary of committing to any stand simply on the basis of what he considered an "imperfect state" of enquiry (*JASB*, June 1832, 1:249).

[5] A description of the Ava fossils written jointly by William Buckland, the Oxford geologist, and William Clift of the Royal College of Surgeons can be found in Crauford 1829.
[6] For a study of Cautley's contributions to Indian irrigation, see Brown 1978.
[7] These specimens had been presented by James Calder. Saharanpur, a district in British India in the Meerut division of the United Provinces, formed the most northerly portion of the Doab, or the alluvial tableland between the rivers Ganga and Jumna.

Fig. 1. Map illustrating "Dr. Falconer's Observations on the Geology of India," showing the Siwalik Range of the Himalayas (dark stripe) and the plains of India (shaded area) forming the valley systems of the Ganges and Indus drainage (Murchison 1868, vol. 1).

Contradicting opinions had begun to be advanced with respect to the age of the Siwalik hills. Captain J. D. Herbert, assistant to the Indian Surveyor General and founder of the journal *Gleanings in Science* was of the opinion that it was identical to the red sandstone of England. Dr. George Govan of the Saharanpur Botanic Gardens thought it belonged to the older alluvial deposits of Buckland. Herbert thus invited a discussion at the Society's Physical Class on the "real bearing of the question of organic remains." Like Falconer, he was wary and warned about the dangers of linking the "lias formation of England" with that of the Siwalik Hills simply on the basis of a few fossil shells and suggested instead that the idea be tested out by "those who have an opportunity" (*Gleanings in Science*, September 1831, 3:265–72).

As a response to Herbert's call for a systematic enquiry into the subject of fossil remains in the tertiary strata of the Siwalik Hills, the Asiatic Society, the leading scientific society in the colony, took upon itself the task of forming an extensive fossil collection from the region. Through the Society's network of correspondents along the length and breadth of the country and the founding of a journal to communicate scientific discoveries, notices, descriptions and drawings, Prinsep was able to function as an indispensable authority. Moreover, the British Association for the Advancement of Science had formed an Indian Committee around this time represented by "some very zealous promoters of science" who included Herbert, Prinsep, James Calder and W. H. Benson (Morrell and Thackray 1981, 502).[8] Prinsep thus had no trouble whatsoever in establishing himself as an "obligatory passage point" and enrolling "allies" to achieve his goal of forming a Siwalik collection. The Siwalik Hills was the "boundary object" that linked together people from various social worlds that ranged from the Canal engineers working at the foot of the hills, the surgeon-botanists attached to the Saharanpur Gardens such as J. F. Royle and Falconer, colonial officials like collectors and surgeons of the towns near the hills such as Jabalpur on the banks of the Narmada, the native State of Nahun on the Hills, to the hundreds of native laborers working for colonial officials in the region or for the native State.

Having received intelligence from Falconer regarding a fossil discovery in Jabalpur, Prinsep wasted no time in publishing a notice soliciting information from the Society's correspondents, his potential "allies" in the Narmada valley. The first willing participant was surgeon G. G. Spilsbury, a "zealous and disinterested contributor" who got his native collectors to fetch him the required specimens for the Society (*JASB*, November 1833, 2:583). Desirous of contributing to science, Spilsbury expressed his willingness to conduct any investigation that the Physical Class might recommend to him. The native collectors had no knowledge of the scientific significance of fossils nor did they yearn for it, but the money and good-will they would receive in exchange for fossil intelligence and specimens was enough for cooperation. Major Burney, the Resident at the Burmese Court who sent fossil specimens in 1834 to Prinsep from Rangoon that he had collected with the help of his native collectors, wrote: "Every Burman, from the Governor to the peasant, strove to make the search after fossils a good speculation, and they were brought to me one by one to secure more advantageous bargain. . . . Some of the fossil teeth will be observed to be injured: this proceeds from small bits having been chipped off by the Burmese to be used in medicine" (*JASB*, January 1834, 3:365).

Once the specimens reached the Society, Prinsep would set about studying them. Finding the Jabalpur specimens to be in a highly mineralized state compared to specimens sent earlier by Royle, Prinsep sought the aid of Charles Lyell's *Principles of Geology* to help him identify them. And having received intelligence from Spilsbury that the "original" discoverer of the Jabalpur fossils was the Collector of Jabalpur, Captain William Sleeman (in charge of the Thuggee department of the Government), he persuaded the latter to examine the spot by virtue of his official position and to "extract if possible some fragments of bone in better preservation" (*JASB*, October 1832, 1:456). Prinsep pointed out that this important field had been ignored by

[8] J. D. Herbert and James Calder edited a collection of geological observations on India, entitled *Geology of the Indian Sub-Continent* (1822), and reprinted in 1981 by Cosmos Publications, New Delhi.

people like Captain William Franklin and other gentlemanly geologists "without the suspicion of the existence of such treasures." Sleeman had also been ignorant of their scientific significance when he had discovered these curious objects in 1831, but now with Prinsep's acknowledgment of his contribution, yet another ally had been successfully enrolled. Almost all scientifically-minded colonial gentlemen of science desired recognition from the local scientific society and thus did whatever they could by way of providing specimens or intelligence. The drawing that accompanied Prinsep's note on the Jabalpur fossils in the Society's *Journal* was meant to enable more experienced geologists to "decide the question of the identity of the specimen with the existing species of elephant; for although it may thus lose in antiquity, it may perhaps gain in value, as an intervening link between the inhabitants of our planet in two geological periods now separated by so strong a barrier of dissimilar organization" (*JASB*, November 1833, 2:585).

In no time, surgeon Spilsbury found himself transformed into "a geologist in spite of himself by the sheer force of accidental circumstances, and the intense interest which such discoveries are calculated to awaken the mind of man." He had risen in power, had become a local scientific authority on fossils, and had established himself as an "obligatory passage point." He enlisted friends and native servants as "allies" in the formation of an exemplar fossil collection for the Society. They began to collect anything and everything uncommon for him. Through local surgeon friends, he had acquired the head of a horned animal, probably a buffalo, embedded in stone and lying below a house, abandoned as unworthy of notice until then. Prinsep described Spilsbury's discoveries as exemplifying the truth of the story of "eyes and no eyes" or the "art of seeing." In this late eighteenth-century fable written for "the instruction and amusement" of the young, the teacher demonstrates how "the observing eye and inquiring mind finds matter of improvement and delight in every ramble in town or country." At the close of a holiday, two pupils, Robert and William happened to take the same path to school. While the former found the walk dull, not having met with a single person or seen anything of interest, the latter who had brought back with him a handkerchief full of curiosities described it as the pleasantest and most instructive walk he had ever had (Aiken and Barbauld 1792–96, vol. 4, 93–109). And so it was in Spilsbury's case, whose conversation with the local lime-burners had led to the discovery of fossil shells; his mahout had brought him an elephant's jaw in a perfect state of preservation; his native carpenter had brought him intelligence of "the skeleton of a giant . . . the fingers of which were said to be three feet long, and that a kneepan served as a weight of five seers to the patel of the village" in the nearby district. Though it seemed like an exaggeration to him, he encouraged the servant to bring him the remains of the "giant." With these discoveries coming to light, an excited Prinsep announced that "an unexpected and most interesting object of geological research" was opening up in India (*JASB*, November 1833, 2:583–86).

The surgeon-botanist, Royle had predicted the presence of fossils in the banks of the Jumna quite early in his researches and as if to confirm his theory, engineers engaged in the removal of obstructions (such as sandstone rocks and kankar banks) to navigation in the Jumna between Allahabad and Agra, accidentally discovered beds of fossils. Prinsep had successfully enrolled the Bengal engineers led by Cautley working on the Doab Canal along the Ganges and Jumna, into the program of building up a collection of Siwalik fossils at the Society. Captain E. Smith sent a box of Jumna fossils to Prinsep and attributed the late discoveries to "the presence of intelligent European overseers" whose curiosity [had] been excited by remains that were a matter of indifference to the natives." Prinsep particularly lauded the sketches that accompanied Smith's report on "Specimens of the Kankar formation, and on the Fossil Bones collected on the Jumna" in the *Journal*. This was not the first time however, that fossils had been discovered by colonial officials on the banks of the Jumna, for a surgeon Duncan had notified the fact of having found elephant fossil bones in the river near Calpi in as early as 1828, but none including Captain Herbert had then given any serious consideration to it, being ignorant of their scientific significance (see *Gleanings in Science* 1829, 1:23). However, it had now become important to glean every single notice of fossils in the region.

On comparing the Jumna fossils with those of the Jabalpur fossils now in the Society's collections, Prinsep discovered that the size and description of the granitic gravel adhering to the bones exactly resembled each other. However having proclaimed himself as the scientific authority, he would not allow Smith's claim that "human bones" had been discovered, despite being aware of the discovery made by French geologists of human remains in the caves of the South of France, because no bones of man, or that of the "monkey tribe" had ever been reported before in India (*JASB*, December 1833, 2:622–32). Later on, while engaged in blasting rocks of the Jumna to clear obstructions, Smith's assistant, Edmund Dean, discovered fossils richer in species, which he faithfully collected and despatched to the Society (*JASB*, June 1834, 3:302; see also *JASB*, September 1835, 4:495–99).

It took more than a year however for the Jabalpur fossil elephant to reach the Society. Examining the specimen with a copy of Cuvier's *Ossemens Fossiles* in hand, Prinsep discovered that the two bones selected by Spilsbury for despatch were fortunately the left and the right femurs, making it easy for him to confirm through the examination of the "condyles of the femur" the "fossil" nature of the elephant. Prinsep was also able to compare their size with those of the femurs of a "modern elephant," thanks to surgeon Col. Tytler, another "ally" who provided recent specimens from his own cabinet in the Hills. Projecting the size of the fossil elephant following the "rules developed by the great teacher of the science of fossil osteology," Prinsep concluded that Blumenbach's "mammoth" of Europe had now been discovered in a distant and unexpected part of the world. With the two fossil femurs, the "immutable mobiles," now on the table before him, Prinsep could not but resist exclaiming that they were as perfect as "any of the sort in the celebrated museum of Paris." As for the horned buffalo head sent by Spilsbury, it was found to be the "first fossil buffalo" ever known to geologists, so remarkable that Prinsep decided it was time to solicit government patronage in undertaking palaeontological research for establishing the antiquity of the fossils. He subtly hinted in the Society's *Journal*:

> a field of so great promise, were it in Europe, would not be left to such slow cultivation. It would be made the object of a special expedition of scientists (as they are called at Cambridge) from the Government, or from some geological association, and the impatience of theorists would soon be satisfied with a full history of antediluvial or postdiluvial tenants of the Nerbuda [Narmada] fossil bason: for it is by no means clearly established yet to which epoch the debris belong. (*JASB*, August 1834, 3:396–403)

It is obvious that Prinsep had the British Association in mind when he wrote it as he was aware of the Association's tradition of appointing Cambridge professors to lead enquiries both in geology and botany. While the recent discoveries in the region were contributing to scientific excitement, collectors were finding it increasingly difficult to send collections to the Society on account of the huge expense involved. It often took more than a year to reach the Society and involved a deft mobilization of capital, labor, and official sanction on the part of the engineer collectors. Prinsep's *interessement* was clearly showing signs of breaking down when Cautley's engineers began to be deterred from sending fossils on account of rising expenses in hiring native diggers and collectors and packing bulky masses and fragile specimens before transporting them by land carriage about 400 miles over a difficult terrain before being sent out to Calcutta, another 600 miles away. Wasting no time, Prinsep recommended to the Society that a special fund be raised towards fossil collecting and this was heeded. Cautley was thus able to report in late 1834 that fossil discoveries were progressing at great pace in the hills but that owing to the rains fragments were being carted to his own house.

Moreover, fossil collecting was now no more an erratic or a random activity, relying solely on intelligence or chance. It had become more focused and systematic with areas for fossil excavation clearly demarcated based on the locations of earlier finds and a better understanding of the geology of the region. Not only was Cautley an "ally" of Prinsep's, but he had also managed to establish his own cabinet of fossils with the help of his subordinate engineers and native collectors, becoming an "obligatory passage point" of sorts himself. However, from want of books and experience, made worse by the fact that none among the collectors were trained zoologists, determining the identity of the fossils proved difficult. Moreover an osteological collection of existing animals that would enable comparative analysis with analogous fossil species was still a desideratum both in the field and in the Society's Museum in Calcutta.

Although the Siwalik Hills had become the center of fossil collecting activity, Prinsep felt it was necessary to explore the hills to its left and right to determine the extent of the tertiary formation. Following a plan of excavation, engineer Lt. H. M. Durand went in search of fossils to the town of Nahun standing on the north face of a mountain at one end of the Siwalik Hills, and found they completely agreed with the Siwalik strata. Engineer Baker had only recently received a fossil elephant tooth as a gift from the Raja of Nahun. Using this as a cue, Durand found a rich deposit of fossils, which included specimens of tortoise, mammals, and fish. Durand's discovery was of special interest as it had now become possible to establish Nahun as a connecting link with the Siwalik Hills. Visiting the spot to confirm his subordinate's discovery, Cautley predicted with confidence the existence of similar deposits at the opposite end of the Siwalik Hills, that is along the Pinjore line of lower mountains, and on the left of the Ganges. His prediction was based not only on Durand's discovery but also on the local belief that remains of giants existed in the neighborhood of the Pinjore valley, near a village called Samrota, "the said giants having been those destroyed by the redoubtable Ramachandra" (a story narrated in the Hindu epic, Ramayana). Cautley cited as evidence for this, the tooth and fragment of a tusk gifted by the Raja of Nahun to engineer W. E. Baker. He also referred to the lines from Ferishta cited in Alexander Dow's History of Hindostan, which mentioned the discovery of bones in the Pinjore valley[9] and thus invited people with "time and leisure to visit Sumrota and the Pinjore valley [where] a fine field [had been] opened out for interesting discoveries of the newer organic remains" (*JASB*, October 1834, 3:527–29).

Prinsep from his side also recommended that the area around the old canal in the Pinjore valley be extensively excavated by Cautley and his engineers. Cautley's own collection began to grow. Engineer Colvin on the other hand, believed that "much good" would accrue to society if all the fossils were presented to the Society rather than if held back in a private cabinet or examined in the vicinity of the deposit. He claimed that his native collecting party was led by "an intelligent man" who had by now "learned to recognise a fossil at sight" and to extract carefully the fossil from its rocky matrix (*JASB*, January 1835, 4:56). Within a short period of excavation by the engineers, a fragment of a leg bone of an elephant was discovered by Baker's native collectors, confirming Falconer's speculation that fossil remains of the larger class of animals may exist in the lower range of mountains. Cautley joined his subordinates Baker and Durand to carefully examine the ravine and slip, near which the fossil elephant fragment had been found and was successful in bringing away at least two perfect specimens, one of an elephant and the other of an animal resembling a camel. Claiming that the lack of a copy of the *Ossemens* had made it difficult to determine the species, Cautley wrote: "Ignorant as I am of fossil osteology, I cannot even propose the animals to which our enormous bones belong: the teeth alone prove some of them to be elephants."

Native collectors were sent to the same spot again and they brought back more fossils, until a large collection originating from three different sites had been formed. However, not always was a "translation" successful. An elephant tooth, referred to as the *Deo ka Sir* (or God's head), similar to the one presented by the Nahan Raja to Baker, had been discovered, but the native collector who found it absconded with it to

[9] Islamic historian Ferishta's work, *History of the Rise of the Mohammedan Power in India* was translated from Persian into English in 1829.

present it to the Raja (*JASB*, November 1834, 3:592–93). On the addition of so many new fossil specimens to the Society's Museum, an elated Prinsep remarked in late 1834: "We are happy to perceive that the Asiatic Society is now in a fair way of possessing a splendid museum of the fossil riches of this newly discovered or re-discovered tract of country, through the exertions of Captain Cautley, Lieut. Baker, and Colonel Colvin, all three engineer officers on the spot, and all equally zealous and disinterested in promoting the objects of science" (*JASB*, December 1834, 3:638). Hopeful of finding more, "as the fossils are in abundance," Cautley sent search parties along the line between the Jumna and Ganges and the result was an unprecedented and massive collection of fossils, making his personal collection swell. Meanwhile, engineers Baker and Durand, realizing the benefit derived from merging their individual collections, colluded to form their own private cabinet of fossils at Dadupur, which also functioned as a fossil dealing establishment. By late 1835, they were rewarded by being elected as members of the Asiatic Society and had begun to publish descriptions on specimens in their Dadupur collection (*JASB*, October 1835, 4:565; November 1835, 4:694; August 1836, 5:486; September 1836, 5:579; October 1836, 5:661; November 1836, 5:739).

Although every one of these engineer-collectors was able to provide at least a geological description of the strata in which the remains were found, none was able to make zoological determinations. This lack was more than leveled when surgeon Falconer entered the scene armed with a sound knowledge of zoology and geology. On tour in the hills at about the same time as the engineers were making big fossil discoveries, Falconer during one of his botanical excursions, occasioned to return through Nahun, well-known by now for the Raja's collection of fossil elephant teeth. Falconer who made enquiries locally about fossils was not only successful in receiving a fossil tooth as a gift from the Raja but also a clue to the actual location of the fossils. Through the "trading zone" that had been just opened he "reaped a splendid harvest" of more than 300 specimens in less than six hours. This was only a couple of days after Lieutenant Baker and Durand had got the first specimens through their "Hindoo" native collectors. Falconer reported to Prinsep that his collection was now "exceedingly rich and varied" containing more species than what "Messrs Crawford and Wallich [had] got from Irawaddi" (*Asiatic Society of Bengal 1883*, chap. 3, 57). He also provided Prinsep with intelligence of Cautley's singular fossil discoveries near the Pinjor Valley, which included a perfect specimen of what was thought to be either an *Anoplotherium* or a new species of the *Palaeotherium*. While a small native state like Nahun discovered that it could use fossils as gifts to help maintain good relations with colonial officials holding high offices, the latter stood to gain being able to enrich their fossil collections. In his own excited note to Prinsep, Cautley wrote:

> The hills were covered with fossils like all the others (how they could have escaped observation before, must remain a source of wonder). Mastodons and Hippopotamus's remains looking one in the face at every step! . . . Although three days at this place, and

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

> superintending my digging parties, I must confess my inability to decide strictly whether we were working in a stratum or in debris. . . . You will join me in an exclamation, which has been upon my lips, day after day, since the discovery of the first fragment of bone – "What shall we have next?" (*JASB*, October 1835, 4:586–87)

Although he awaited Prinsep's directions with regard to despatching the collection to the Society, Cautley legitimized the holding back of the collection by arguing that it provided a greater chance for a final zoological classification when kept that way. It is to be noted that at about this time, Falconer and Cautley, Prinsep's allies had now begun a partnership, like Durand and Baker had done before them. If Falconer was the scientist with zoological and geological expertise, Cautley possessed a remarkable collection of fossil animals by virtue of having men at his command to excavate with care and intelligence. One of the ways by which Falconer made the collusion possible was by crediting Cautley as the original discoverer even when Cautley had no clue about their significance at that point of time. He wrote: The "most perfect portion I have yet seen of these fossil bones has been in his [Cautley's] possession several years, without, however, his being aware of its nature" (*Asiatic Society of Bengal 1883*, chap. 3, 59). Both, Cautley and Falconer were however careful in acknowledging Emperor Feroz [in 1360 A.D.] as the original discoverer of the fossils.

Prinsep remarked in the *Journal* in early 1835 that the "Museum at Seharanpur is now richly stored with subjects . . . we [cannot] refrain from announcing to the world the rapid progress made at the onset, in this remote theatre of discovery" (*JASB*, March 1835, 4:179). Cautley and Falconer jointly authored their first paper, on the *Sivatherium Giganteum*, which was read out at the meeting of the Physical Class in September 1835. They explained that the fossil had been named after the Hindu God *Siva*, having been discovered in the tract that may be included in the Siwalik formation to "commemorate this remarkable formation so rich in new animals. They added that the Sivalik or the sub-Himalayan range of Hills was considered in the Hindu mythology the roof of *Siva*'s dwelling and the whole tract between the Jumna and Ganges, the habitation of *Siva* (*JASB*, January 1836, 5:38).

By the end of the year they had together produced a synopsis of fossil genera and species in their collection and had reconstructed a vast and almost complete menagerie of extinct fauna of India, analogous to what Cuvier had done for Europe (*JASB*, December 1835, 4:706–07). It was this scientific catalogue of the Siwalik fossil zoology, though preliminary and prepared mainly by Falconer based on Cautley's vast and rich collection that established the Siwaliks as a distinct geological formation and won the Wollaston medal in 1837. The formation of such a rich collection, although laborious and expensive, had given Cautley "much amusement and gratification" because he felt satisfied at making it possible to shed light on the connecting links in the chain of mammalia, and to add the family Quadrumana to their catalogue.[10] The Siwalik

[10] British Library (hereafter BL): Add Mss 28,599, letter dated Saharanpur, 7th May 1838, f. 5.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

fossils included some of the earliest Quadrumana ever discovered, some even older than the ones Cuvier had examined. The discovery was used as a means of proving the progressive development of organic life, for which Charles Lyell lacking evidence was fighting a losing battle.

In only four years (1832–36), the Society's fossil collections had become a formidable one, thanks to Prinsep's ability to sustain an "obligatory passage point." Falconer and Cautley were missing from his list of persons acknowledged in 1836. It is interesting that he now remarked that the

> foundation of our fossil collection was but laid four years ago, and already through the contributions of Col. Burney, Dr. Spilsbury, Capt. Smith, Mr. Dean & now enriched by Col. Colvin's vast store of specimens, it has become necessary to devote an entire apartment to this instructive department of natural history. Our smallest return of gratitude to those who have been at such a considerable expense in promoting the Society's interests will be to do honor to what has been generously bestowed, by making up fit cabinets to exhibit them to the best advantage, and by spreading the knowledge of them as expeditiously and widely as possible. (*JASB*, March 1836, 5:181)

Lord Auckland: Patron of Colonial Science

By the mid-1830s, a patron of science had appeared on the scene in the form of George Eden (Lord Auckland), the Governor General of India. In 1837, two years after he took up his post as Governor-General, Lord Auckland began a tradition of holding regular "scientific soirées" at his residence, the Government House in Simla. The *India Review and Journal of Foreign Science and the Arts* (hereafter *India Review*)[11] alluded to the first such "party" as signaling the dawn of a new scientific area in British India similar to the "operations of that splendid institution, the British Association" (*India Review* 1837, 1:334). Colvin exhibited a fossil hippopotamus and crocodile from the Siwaliks at the third scientific party held in January 1837 (ibid., 459).[12] And at the next, several specimens of fossils were laid on the table for inspection, including the *Sivatherium* collected by Cautley and Falconer (ibid., 597). Auckland wasted no time in relaying the exciting discoveries to London and that very year, both Cautley and Falconer were awarded the Wollaston medal by the Geological Society. This marked the beginning of the involvement of the colonial Government in the collecting activity.

Soon after, Cautley received a letter from Lord Auckland, requesting him to "furnish some descriptions of the remains . . . of the most valuable portions . . . in order that it

[11] A journal begun by Frederick Corbyn in 1837 and published in Calcutta, it claimed in the preface to the first volume that though it combined the character of Thomson's *Records of Science* and Jameson's *Philosophical Journal* and assumed the appearance of the *Mechanic's Magazine* and *Repertory of Inventions and Arts*, it was basically a review of science and a register of discoveries in India.

[12] Casts from Colvin's beautifully preserved lower jaw of the *Sivatherium* were prepared for the Asiatic Society (see *JASB*, February 1837, 6:152).

Fig. 2. Lord Auckland being received by the Raja of Nahan in 1838. If the Raja provided the clue that led to the massive discovery of Siwalik fossils, it was Lord Auckland who masterminded the transportation of these to London (Eden 1844).

may be conveyed to the Hon'ble The Court of Directors."[13] He had come to learn of the existence of Cautley's huge private collection during an official visit to the native State of Nahan (see fig. 2).[14] In his response, Cautley expressed a desire to offer the whole collection, either to the British Museum, the India House, or the London Geological Society. Being a fellow of the latter Society, he had a clear preference for it but was afraid that lack of funds and space, and the Society's disinclination to collect extensively from one locality, combined with the belief that fossils were objects for a national museum rather than for the comparatively private one as a scientific body, would stand in the way of its acceptance.

Cautley now had a vision of the form his collection should take and how it should be used for purposes of science. His greatest desire was that the entire collection should find a place in London, the "Centre of all Sciences," be open to all and made accessible to those wishing to study and compare "without the interruption attendant upon glass cases and prohibitive to close examination of specimens." He insisted on keeping the collection undivided for he believed that:

> Every fragment is likely to elucidate some point in the structure of the animal to which it belonged, it is hardly possible therefore to consider any one of them as duplicate. The

[13] For the Governor General's letter to the Court of Directors respecting Cautley's collection, see BL, IOR (India Office Records): F/4/1866 no. 79252, letter dated 3rd May 1839.
[14] BL: Add Mss. 28,599, letter from Thomason, Officiating Secretary to the Geological Society, dated Simla, 21st April 1838, f. 4.

> student in turning attention to any one particular genus will in all probability have to work out his results. [Thus] 500 different portions of the skeleton and fragments which might at any selection be thrown aside – might be the most valuable to the osteologist altho the most uninteresting to the common observer – age and system of dentition can only be shewn by an infinity of specimens which to the person unacquainted with the subject would be considered duplicates.[15]

After two months, much as he predicted, Cautley heard from the Geological Society, declining his offer. The Secretary explained that the Society was grateful to Cautley for his contribution to the science of geology and would support it "in any way [that would] further his generous and enlightening purpose" but could not accept the offer because of lack of funds.[16] The Trustees of the British Museum representing the national collection however accepted and having already made arrangements with the Board of Control and Admiralty for assistance in its transportation to England, hoped that the Indian Government would cooperate.[17]

In early 1839, Cautley informed Falconer, his partner, about the recent developments, and reiterated his vision, expressing hope that it

> [would not] be divided nor separated, in this country at least, and if the Trustees wish to act up to the wishes of the Donor, it will neither be divided or separated hereafter. I have no wish to get *rid* of the collection, if I had, I could easily have done so in this country, by giving it away and as a whole, it will to Geologists at least be one of the most valuable collections that has ever been made. It is useless talking of duplicates, nor are there "best specimens" – every fragment tends to the illustration of its neighbour – and it is for the purpose of proper illustration, that the maintenance of this Collection undivided is so absolutely necessary.[18]

Cautley had spent almost £500, collecting and carting about 300–350 chests of fossils, mainly from that portion of the Siwalik Hills that consisted of sand, clay, shingle and conglomerate lying between the rivers, Jumna and the Sutlej. He held back cautiously some 15 or 20 chest loads of the "most valuable Specimens," which he planned to carry later to London privately. The Trustees of the British Museum, though willing to defray the expenses of packing and "every charge of carriage" from Saharanpur, had warned Cautley about maintaining the strictest of economy at all events. As soon as the Governor General had heard from the Trustees, he issued instructions to the necessary Government departments, ordering them to provide able assistance to Cautley and took care to remind Executive Engineer Reilly at Delhi of "an act accomplished with little expense," the transportation of a "Buddhist Pillar" gifted by Raja Hindoo Rao

[15] Ibid, letter dated 7th May 1838, f. 5.
[16] Ibid, letter dated 9th July 1838, f. 11.
[17] Ibid, letter dated 20th July 1838, f. 9.
[18] Ibid, letter dated Camp Poor, near Shamli, 13th March 1839, f. 16.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

of Delhi to the Asiatic Society, Calcutta.[19] The Government was however willing to accept that the actual scale of operation for the removal of a single stone was not the same as moving the "immense and ponderous" collection of fossils.[20] The fossils were temporarily stored at the Saharanpur Pay Office in order to be conveyed down the Ganges to Calcutta. As an economic measure, the chests were to be transported in the boats that conveyed Ordnance stores to the Upper Provinces, which frequently returned empty.

Cautley was of the opinion that the Ordnance boats would not answer well because he knew that the Doab Canal was quite unfit for boats or rafts in the condition that it was in. Not wanting to risk wrecking 20–25 boxes of fossils, he wished the Commissariat would lend him carts for carting them to Delhi. The alternative plan however was to buy boats at Rajghat and load the fossils at that point, about 12 miles away from Saharanpur near Chilkana. In between organizing the logistics and money for the transportation, Cautley had also to attend to his duties as Superintendent of the Canal and had to make up for the loss of time suffered during the cold weather, while at the same time illuminating the local landed class (the Zamindars) on the art of constructing Rajbuhas (main water-courses carried out from the trunk Canal) (Cautley 1853; Brown 1978). Cautley confessed to Falconer that the happiness in seeing "a running stream of water on lands, where water has not been seen before" was as great to him as the collecting of Mastadons and Hippopotamus remains.[21]

The fossil chests began to be moved gradually at every suitable occasion towards Delhi, on the return canal carts, in packs of six clamped together with iron. Under the charge of Sergeant Brew of the southern district of the Canal, they were to be lodged at the Canal yard in Sanouli. In November 1839, even after six months of periodic despatch to the Ordnance Magazine at Delhi, by return carts and other opportunities, only 55 chests had reached Delhi, a large number still remained undespatched. Heeding Lord Auckland's suggestion, six chests containing very valuable portions were sent privately to London through Cantor & Sons, Calcutta, to reach there ahead of the rest.[22] These included the crania of Mastodons, a superb cranium of Mastodon *Elephas* in two fragments (but "capable of being united"), and other heads

[19] BL, IOR: L/F/2/86, Finance and Home Dept, dated 3 May 1839.
[20] BL: Add Mss 28,599, letter dated Simla, 1st April 1839, f. 21.
[21] Ibid, letter dated 13th March 1839, f. 17.
[22] However, by some oversight, these cases remained in the go-downs of Cantor & Sons until March 1841, more than a year (November 1839) after they had been despatched! But when the chests were actually despatched to London they were accompanied by two extra chests containing a skeleton of a Rhinoceros from Assam that Cautley had procured as a recent analogue. See British Museum Standing Committee Report (BMSCR), dated 12th June, 1841, ff. 5654–5, in which Charles Konig, the Minerals Keeper in charge of arranging the fossil specimens at the British Museum reported on 9th June, 1841, that "among the specimens already set up, the complete cranium of a new species of Mastodon [was] much superior to that for which £150 was paid some time ago." He also mentioned another head in progress of preparation worth probably three or four times this sum.

of Elephants and Mastodons. The sixth chest was a miscellaneous collection including a splendid head of the *Hippopotamus Sivaliniens* (upper and lower jaw united), a portion of a lower jaw of the Rhinoceros, a cranium of a "Deer-Horse" and that of a fossil Camel.[23]

By February 1840, the Delhi Magazine Office realized that they were running out of space to accommodate more chests of fossils.[24] Therefore the remaining chests, numbering about 160, had to be detained at Selimpur Chowki, near Delhi.[25] After about seven months, 187 chests were reported ready for transportation to Delhi, the total expenditure amounting to Rs. 2,300. The Governor General's office having sanctioned the required amount, it was possible to insure the whole for Rs. 1,271. By August 1841, the fossil chests had reached the Arsenal at Fort William to be finally shipped to England.[26] Eventually, Cautley received an acknowledgment and receipt for the first despatch of fossils from the British Museum. He later sent a small case containing miscellaneous fragments, which included a valuable collection of teeth of the *Rodentia*, *Sivatherium* and rhinoceros (both young with milk teeth), the jaws of a diminutive kind of hippopotamus and the fragments of a fish skull. It also contained the only remains of the *Anoplotherium* in Cautley's collection and the vertebrae of an animal akin to the giraffe. Altering his earlier decision to carry the more important fossils to London himself, he now sent them off through various private channels.

It was about this time that Cautley received the deeply disappointing news that the Trustees of the British Museum had no plans of establishing a "room of skeletons articulated for Comparative Osteology" in the Cuverian manner as he had envisaged.[27] Cautley had envisioned a room with a dozen skeletons of the living species adjoining the room with the fossils, which he thought "would render this part of the National Collection perfect for examination and reference." He had even highlighted the fact that a Mastodon in his collection corresponded exactly with a "solitary specimen described by Cuvier" and delineated in the first volume of the *Ossemens*. And in fact, it was to demonstrate the Cuverian system, that he had specially despatched a skeleton of the living species of an Assamese rhinoceros. However, the Trustees found no use for the specimen and Cautley was obliged to gift it to Richard Owen of the Royal College of Surgeons. Meanwhile, Cautley sent a second box containing miscellaneous objects, which included skulls from Jabalpur and the Bolan Pass in Afghanistan and some Himalayan fossils collected at an elevation of about 18,000 feet. In all, it took a little more than two years for the 187 cases of fossils to reach their destination in

[23] BL: Add Mss 28,599, letter dated Suharunpoor, November 16th, 1839, ff. 25–26.

[24] Messrs. Cantor & Sons informed the British Museum that a shipment of several cases of Siwalik fossils had been despatched to them. See letter dated the 16th January 1840. BMSCR: 13th March, 1841, f. 5587.

[25] BL: Add Mss 28, 599, letter dated Doab Canal Office, 10th July, 1840, f. 35.

[26] BL, IOR: F/4/1932 no. 83168.

[27] BL: Add Mss 28, 599, letter dated British Museum, 16th July, 1841, f.78. Also, see BMSCR: dated 10th July, 1841, ff. 5668–9.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

Date of Despatch	Collection	No. of Fossil cases
Nov. 16, 1839	British Museum	6
March 20, 1841	ditto	187
Sept. 28, 1841	ditto	2
Oct. 9, 1841	ditto	2
March 16, 1842	ditto	15
Nov. 30, 1842	ditto	2
Total		214
October 18, 1842	India House	22
Grand Total		236

Fig. 3. A summary of Cautley's fossil despatches from Saharanpur to London (1839–42).

London. By the end of the year, an additional fifteen cases reached the Museum, now raising the total number of fossil cases to 202.[28] Cautley also sent 22 cases of fossils to the India House in 1842.[29] See the table which summarizes Cautley's fossil despatches from Saharanpur to London from 1839 to 1842 (fig. 3).

Siwalik Fossils at the London Market

Museums and scientific societies during this period were very keen on acquiring visually pleasing and scientifically significant fossils. Complete articulated skeletons of marine reptiles were particularly desirable, and signified cultural and scientific status (Knell 2000, 193–94). The newly discovered fossils from the Siwalik formation also reached the London market. As early as August 1838, the Rev. Josiah Forshall, Secretary to the Trustees of the British Museum was informed of a sale by L. Reffay of osseous remains including that of a Mastodon *Elephas* from the Siwaliks, this one at Steven's Sale Room, King Street, Covent Garden. The Trustees had decided that no more than £60 was to be paid for the Mastodon skull. Charles Konig, the first Mineralogy Keeper of the British Museum was ordered to bid for it, amidst rumors that there was severe competition for acquiring that lot and various others including "instructive portions of the heads of new species of Hippopotamus, Garial and Crocodiles."[30]

[28] BMSCR: dated 30th August 1842, ff. 6910–11 and 10th December, 1842, f. 6076.
[29] BL, IOR: L/F/2/78, dated November 1843. Also see F/4/2016 no. 90228.
[30] Natural History Museum, London (NHM): DF 105/5, dated Nov. 9th 1838.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

Lord Henry Brougham[31] and William Buckland were also at Steven's Sale Room on the occasion, and were of the opinion that the skull ought to go to the British Museum even if the bid went up to £150. At the same time, the Trustees had instructed Konig not to agree to any amount more than £60. Konig himself considered £150 excessive having paid a lower price of £147 for the skull of an American Mastodon at a former sale. However, the presence of a new competent, the Royal College of Surgeons (which did not bid in the previous one) forced Konig to bid for a higher amount. There were also fears that the head would be taken away to the Continent for sale in the event of it being unsold, a consequence at once regrettable and undesirable. In the end, Konig bid for it at £125, more than double the initial estimate, and successfully acquired the cranium specimen for the British Museum. The problems encountered in fixing the value of the fossils were many but the sum of £125 had nevertheless to be justified to the Trustees. Konig thought he had almost found a way out, when he came across Cautley's note and drawing of a Mastodon skull in his possession in Prinsep's *Journal*. The skull seemed "most imperfect" compared to the Reffay specimen he had just bought, judging from the drawing, but to his distress, the editor had not stated if the specimen in Cautley's possession was or was not the superb specimen of the *Mastodon Angustidens* that had been discovered of late.[32]

Falconer in London: The "Heterotopic" Man of Science

Communicating Siwalik discoveries in the Metropolis

One of the first major palaeontological assignments that greeted Charles Konig in 1842 as Mineralogy Keeper at the British Museum was the preparation of the newly acquired Cautley fossils for exhibition, amongst which were the various osseous remains of the by now well-known *Sivatherium*, particularly the gigantic cranium of a male, "a remarkable and instructive specimen."[33] It was not until two months later in early 1843 that the Trustees actually got around to examining the great Siwalik specimen. They proceeded to the Gallery of Minerals, inspected the head, ordered it to be provided with swivel and other fittings to render it more suitable for examination and ordered that a mold be prepared to enable scientific institutions to possess a cast of this spectacular specimen. Casts were also to be made of those parts that were more effective and useful when exhibited separately than as part of the original specimen.[34]

By March 1843, Falconer had arrived in England unwell and exhausted, bringing with him 48 cases of Siwalik fossil remains collected with the help of his native

[31] Lord Brougham was one of the founders of the Society for the Diffusion of Useful Knowledge (1825) and the University of London (1828).
[32] NHM: DF 105/5, dated Nov. 9th 1838.
[33] BMSCR: dated 11th February, 1843, f. 6130.
[34] Ibid, dated 8th April 1843, f. 6183.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

collectors over a period of about nine years. In addition to these fossils, there were four chests of skeletons of extant species for comparison with their fossil analogues. Falconer's collection was divided between the India House and the British Museum, with the greater portion initially going to the former and a large number of rare specimens required for completing a series, to the latter.[35] He wrote to Cautley of the "treat" he had received on arrival in England and of the facilities available to the student of palaeontology there. If for collectors like Cautley it sufficed to make a rich collection, for Falconer, a collection was simply the means of beginning a long period of study and theoretical research. Thus having briefly recovered from physical exhaustion, he began his visits to the British Museum, often in the company of his friend, Richard Owen of the Royal College of Surgeons, to inspect and examine the Siwalik fossils being prepared for exhibition.[36] Falconer began putting pieces of a huge jig-saw puzzle together and crafted his *Colossochelys Atlas*, a monument analogous to Cuvier's *Megatherium*. An "artificial reality," it was a "configuration of the material world that is real but is not identified with the 'nature' that is supposed to exist prior to and independently of human intervention" (Golinski 1998, 31–32). The remains of the *Colossochelys* had been collected by him along a range spanning 80 miles of the hills, over a period of nine years, and belonged to animals of differing size and antiquity. A perfect skeleton of the tortoise was difficult to come by and so had to be reconstructed along the lines of Cuvier.

Falconer's ability to "translate" the sacredness that the natives attributed to fossils into his own scientific concerns was best reflected in his zoological nomenclature of the Siwalik fossils. He incorporated elements of Hindu mythology into it and began by naming Baker's fossil elephant *Elephas Ganesa* after the Hindu elephant-god *Ganesa*. Like the *Sivatherium* (after the Hindu God *Siva*, the destroyer), he named two other fossil rodent species, the *Visnutherium* (after the Hindu God *Visnu*, the preserver) and another *Brahmatherium* (after the Hindu God *Brahma*, the creator).

After about a year's study of the Cautley's specimens in the British Museum, Falconer decided that it was time to present his discoveries in England and this he did at least before three institutions, the Royal Asiatic Society of London, the British Association, and the Zoological Society of London. Over two days, on March 26th and May 14th 1844, Falconer presented an extempore paper, "On the Osteological Characters and Palaeontological History of the *Colossochelys Atlas*," before the Zoological Society of London (Murchison 1868, 362–70). Falconer's interests were now more in fossil zoology than in geology. Numerous huge fragments obtained from all parts of the skeleton except the neck and tail of the great tortoise were exhibited on the display table. Alongside was displayed a diagram of the animal reconstructed to life-size and a few rough sketches of the *Colossochelys* etched on glass by means of fluorine extracted

[35] However, all the specimens in the India House were later moved to the British Museum (see Murchison 1868, 1, xxxvi).
[36] BL: Add Mss 70844, f. 78.

from its own bones. The length and height of the *Colossochelys* were believed to be about eighteen feet and seven feet respectively. In fact, the fossil earlier called the *Megalochelys Sivalensis* had been renamed the *Colossochelys* by Falconer to convey more evocatively its immense size.

Also included in his paper were the results of a chemical analysis on the bones performed by the chemist J. Middleton at the Laboratory of the University College, London. Interested in the "mineral condition" of the remains, Falconer drew upon the discoveries of the use of fluorine for establishing antiquity made by "distinguished authorities in chemistry" in Pompeii and Herculaneum. The idea was that fossils absorbed fluorine from the soil in which they were buried and that the amount of fluorine in a fossil would increase with time, providing thereby an indication of age. Observing this in 1844, Middleton tried to build a time scale based on fluorine content in fossils (Middleton 1844). The standard he chose was the quantity of fluorine in a Greek fossil 2000 years old. Fragments of the giant fossil tortoise were "pounded in a mortar, stewed in a crucible, and so curiously dealt with as to be made to distil, as it were, their most hidden humors for the express purpose of engraving their own image on a plate of glass."[37]

The first paper was weighed down by anatomical details and chemical analysis of the fossil tortoise, leaving the discussion of Falconer's theory linking Siwalik palaeontology and Hindu mythology for his next communication to the Society. He spoke of how it was not possible to predict the cause or the time of the giant tortoise's extinction, but that some clue certainly existed in the "cosmogonic speculations of almost all Eastern nations" that refer to a colossal tortoise and the elephant. As part of the rhetoric used in presentations such as these, he threw a question at the audience: "Was this tortoise a mere creature of the imagination, or was the idea of its drawn from a real entity, like the *Colossochelys*?" Here in Falconer, we find a glimpse of the antiquarian-naturalist method employed by the late eighteenth- and the early nineteenth-century Orientalists who sought "real" analogues for plants and animals in Hindu mythology, as with the "spikenard of the ancients" and the chimerical "two-headed snake" of the natives. Such a method involved a kind of "translation," the bridging of two seemingly opposing worlds, the mythological and the real, the native and the colonial, helping the colonial naturalist order the new world in familiar terms. Falconer also alluded to the mythology of the Iroquois Indians, which spoke of a tortoise tradition. Comparing the fossil to the giant tortoise of Hindu mythology, he cited the Hindu fable where "the infant world [was] placed on the back of an elephant, which was sustained on a huge tortoise" (see fig. 4).

Falconer claimed that no fable had corresponded so totally with the fossil discoveries as much as this fable, especially in what relates to "the second incarnation of god Vishnoo," produced from the churning of the ocean of milk by means of Sumeru,

[37] Referred to as the Bohemian emerald, calcium fluoride was first used for etching on glass.

Fig. 4. "The elephant victorious over the tortoise, supporting the world, and unfolding the mysteries of the *Fauna Sivalensis*," from a sketch in pencil by Prof. Edward Forbes, found in one of Hugh Falconer's notebooks (Murchison 1868, vol. 1).

the mountain and the serpent-rope, Vasuki. Vishnu, the god of Creation, emerged from the ocean and took the form of the tortoise, supporting the world on his back. To describe the fable, Falconer cited William Jones' translation of a stanza from the twelfth-century poet Jayadeva's *Gita Govinda*. He also narrated the story of Garuda, the sacred avian vehicle of god Vishnu, which with one claw carried away a gigantic elephant and with another a colossal tortoise and then asked passionately:

> are we to regard the idea [of a gigantic tortoise] as a mere fiction of the imagination, like the Minotaur and the Chimaera, the Griffin, the Dragon, and the Cartazonon . . . or as founded on some justifying reality. The Greek and Persian monsters are composed of wild and fanciful combinations of different portions of known animals into impossible forms, and are merely the progeny of uncurbed imagination. But in the Indian cosmogonic forms there is an image of congruity which may be traced through the maze of exaggeration with which they are invested. We have the Elephant then as at present, the largest of land animals, a fit supporter of the infant world; . . . and the *Colossochelys* would supply a consistent representative of the Tortoise that sustained the Elephant and the world together.

Falconer claimed that just as the Pterodactyl had "more than realized the most extravagant idea of the Winged dragon," so did the huge tortoise to the lofty conceptions of "Hindoo mythology." He also cited Ward's *History of the Hindoos* to prove through the fable of the Garuda, the King of Birds that the *Colossochelys* had only become extinct "within the human period" (Murchison 1868, vol. 1, 388).

Falconer claimed that the Siwalik fossils abounded in monuments of this sort, and wondered whether the *Hippopotamus Paloeindicus* was not a contemporary of man. To find out he resorted once again to the ancient traditions of India. Through a Sanskrit scholar Radhakanta Deva, he discovered that it was referred to under the name "Jala-Hasti" (Water-Elephant) in the *Amarakosha* and *Subda-Ratnavali*. This was further confirmed by the Oriental scholars, H. T. Colebrooke and H. H. Wilson, both of whom were now associated with the Royal Asiatic Society, London. On the basis of this evidence, Falconer established that the ancient inhabitants of India were familiar with the Hippopotamus as a living animal (ibid., 644). Falconer was however cautious and reminded the audience that though undue reliance on "the tendencies of mythological tradition, which are generally so vague and uncertain" cannot be considered rational, they nevertheless mattered hugely because a very large part of mankind derived its beliefs and world-view from them. By the end of his presentation, the *Colossochelys Atlas* and the Siwalik fossils as such had attained almost a "national" status.

After a month, over two evenings (on June 1st and 8th 1844), Falconer presented his paper entitled "Ancient Animal Races of India" at the Royal Asiatic Society's Rooms, at Grafton Street, London. The Royal Asiatic Society was founded in 1823 by H. T. Colebrook for returning colonial officials interested in the arts and sciences of Asia and the present President was none other than Lord Auckland. Falconer's subject again was "the antiquarian history" of his fossil monument, the *Colossochelys Atlas,* "back from the epoch where we lose all indications of mankind" (ibid., 2). The audience was shown illustrations of the giant fossil, the first of its kind, he claimed, that allowed an invocation of the "gigantic" found in the fables of the Pythagorean and Hindu cosmogonies. He began by citing the appropriateness of the evening's lecture at what was an "Asiatic" Society before he presented his thesis:

> The antiquities and literature of the East have been, from [their] commencement, the special field of investigation to this Society, and to the parent institution in Calcutta. A rich vein has been opened, branching in a thousand ramifications, and fertile in results of the deepest interest. The human race has been traced farther back into time in the East than in any other quarter of the globe; and the tendency of all inquiries has been to show that the civilization of at least a large section of mankind first dawned in the valley of the Ganges. The language or the mythology, the arts and the sciences of India, have all been found more or less engrafted on surrounding nations.

The *Colossochelys*, a Siwalik monument, had now become both a national and a cultural icon. It had been bestowed with this exalted iconic status not only because of its scientific significance, but also on account of the awesome spectacle it afforded to the common observer at a museum, a status that only a few fossils like the *Pleisosuarus* could attain (Knell 2000, 194).

Lobbying for Funding

Falconer required financial assistance to complete the catalogue of Siwalik fossils at the British Museum as it was impossible to take up such a task privately. Having presented his paper at the two societies, it had now become easier for him to mobilize support. On his insistence, a memorial was submitted to the Court of Directors in July 1844 by the Royal Society president, Marquis of Northampton; the Asiatic Society president Lord Auckland; Henry Warburton, president of the Geological Society; Roderick Murchison, president of the Geographical Society, and William Buckland, the Oxford geologist requesting patronage. The committee argued that it was not sufficient:

> that the collection should be neatly arranged and displayed in the British Museum, [but that] a publication should be undertaken and completed which will convey to men of science in both hemispheres a knowledge of the contents of the Sewalik Hills and such a publication to be of any value, must be copiously illustrated by well-executed figures and plates. . . . Great anxiety prevails on the part of the most distinguished comparative anatomists and students of fossil Zoology in Europe to know the details of the anatomy of this ancient Indian fauna. (Murchison 1868)

To drive home the urgency of the request, the gentlemen alluded to an application made by the eminent French comparative anatomist, H. Ducrotayl de Blainville (head of the Department of Comparative Anatomy at the Musée d'Histoire Naturelle, Paris, a chair once occupied by Cuvier),[38] to the British Museum, requesting permission to take drawings from the principal fossils of the Siwalik Hills displayed at the Museum, for insertion in his new work on fossil osteology. The elite group also applied their influence on the Trustees of the British Museum for arranging the exhibition of the collection and for their "general co-operation with the Court of Directors." They explained that the proposed publication could not be materialized until the whole of Cautley's collection had been displayed, which in turn would be possible (despite Konig's "indefatigable application") only if an immediate expenditure of money and space was sanctioned for the work. Extraction of the organic remains from the stony matrix, a process both laborious and delicate, required a substantial amount of money. The response of the Trustees was not a completely favorable one. While on the one hand they offered to provide Falconer with all "facilities in their power for the examination and delineation of any specimens in the Fossil Zoology of the Museum whether belonging to Captain Cautley's collection or otherwise," on the other, they refused to make available the required amount of money for the extraction of fossils from their matrices.[39] Lord Auckland and Warburton were now forced to direct their efforts to the British Government to sort out the matter.

From Falconer's side, he had already written to the Secretary of the British Museum, pointing to the limited usefulness of a publication of a "series of selections and figures brought out even in a great general work like that of de Blainville" for the study of

[38] NHM: DF 100/5, letter dated 23, Norfolk Street, March 8th 1844.

[39] BMSCR: dated 27th July 1844, ff. 6481-2. Also see IOR: L/F/2/86, letter dated British Museum, 2nd August, 1844.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

palaeontology. He was obviously insecure with the prospect of Blainville becoming the first publisher of Siwalik fauna illustrations. After all, he was only awaiting the sanction and patronage of the Company, for a large illustrated work on the entire Siwalik fauna, and on which some progress had already been made. Falconer had also suggested in his letter to the Court of Directors that the publication was a matter of national pride for the British nation yielding additional scientific significance to what was undoubtedly a valuable collection. Though Falconer's estimate for completing the work was a whole five years,[40] the Court of Directors only granted three, during which time he was to receive his usual pay as Assistant Surgeon on the Bengal Establishment.[41]

The specialist societies now decided to use the British Association to "give a successful shove to a lobby they had already launched" (Morrell and Thackray 1981, 352). Falconer was provided with an opportunity to present his thesis at its meeting in York on September 28th 1844. It was again on the *Colossochelys*. The *Edinburgh Journal* for November 1844 reported that the members were surprised on entering the hall to see the picture of a tortoise displayed on the green screen above the speaker's head, "exhibiting an animal the same in form as land-tortoises, but about twelve feet long." The temporary screen in front of the orchestra recess displayed maps and diagrams, including "a very spirited and cleverly executed restoration drawing of the Sewalik colossus, done by Mr. Scharf, under the superintendence of Dr. Falconer, to the natural size, measuring, exclusive of curves, about 18-$^1/_2$ feet." In addition, on the stands on either side of the lecturer, fragments from all parts of the *Colossochelys* were exhibited as had been done in the other lectures. The scientific audience was treated to a spectacular feast never before experienced. Falconer now argued that that palaeontology was as much about form and structure as it was about theories of extinction. It was fossil zoology that interested him more than geology. No remarkable fossil of the *Testudinata* (land-tortoises) had ever been discovered before, even when numerous reptilian fossils such as the Iguanodon, *Megalosaurus*, and *Labyrinthodon* had been. Falconer began his lecture by stating that the discovery of the *Colossochelys* precisely filled that lacuna. After a brief description of its anatomical details, Falconer began to speak on his favorite thesis that linked Hindu mythology with Siwalik palaeontology. The lobbying worked successfully and Robert Peel, the head of the British Government responded positively by making a grant of £1000 for the preparation and exhibition at the British Museum.

Falconer's Vision: Exhibition, Fossil Replication, and the Catalogue

Falconer's demands to the Trustees had been two-fold: that the fossil preparation be executed by an efficient body of workmen before being displayed; and that a room in or about the Museum be arranged for the preparation of drawings and descriptions.

[40] BL, IOR: L/F/2/86, letter dated London, 23rd July, 1844.
[41] BL, IOR: L/F/2/93, letter dated 18th Sept. 1844.

The Trustees replied that the "greater part of the more obviously useful specimens had already been selected from Captain Cautley's collection" and that about one-fifth of the whole mass had been prepared for exhibition. They added that one mason had already been employed for about three years and a second one for eighteen months, for the task of extracting fossils. Examining the remaining four-fifths, Falconer estimated that only one-third of it would be of any use, the remaining being worthless for both the scientist and the common observer. However, heeding Falconer's demands, a shed was erected in the inner court of the Museum by the end of 1844 to be used as a work place for the artists. An application for a special grant of £10,000 was further made by the British Museum to the Lords of the Treasury to provide the means for accelerating the work of extraction and for "rendering them more immediately available to the progress of science." Two more masons for the extraction work were thus sanctioned and at last the work began in full earnest.[42] However, by July 1845, the space, which had been arranged for Falconer by the eviction of the Pay Office, was no longer available as H. H. Wilson, the Librarian of the British Museum had lodged a protest against what he considered an inefficient use of public space when occupied by an individual for extended periods of private study.[43]

Meanwhile, Falconer had set about the task of publishing a catalogue of specimens at the British Museum, the *Fauna Antiqua Sivalensis*. However, he soon found the work extremely demanding given the outdated technology of the letter-press and the single-handed labor of comparing and identifying the enormous mass of material and the inclusion of numerous scientific references. Moreover, Falconer was strained by the thought of the Company not allowing him more time off for official duties. In all, thirteen artists were employed to produce the lithographic drawings. Enormous artistic labor had to be invested in the project and many of the drawings could only be accomplished in a minimum time of 120 hours. G. H. Ford was the only one to be continually employed on the fossil drawings from the outset. Most of the specimens to be drawn had already been selected and a large part delineated preparatory for being transferred to the lithographic stones. Falconer had to leave for India soon, but arranged with Dr. Gordon Melville, an able comparative anatomist, to superintend the work in his absence. All that was needed was continued access to the room under the control of the Palaeontological department, for the employment of the artists and for comparison of specimens.

The first part of the publication was announced in the prospectus of July 1845 with the remainder, amounting to 12 parts, proposed to be completed in the next four years, at the rate of three parts every year. The first two parts were published in 1845 and 1846 respectively. Falconer warned in the preface that the order of describing families depended "more on the state of preparation and convenience of materials, than upon any strict principle of zoological arrangement" but cited the example of

[42] BMSCR: dated 14th December, 1844, ff. 6534–6.
[43] BL, IOR: L/F/2/93, letter dated 4th June, 1845.

https://doi.org/10.1017/S026988970500058X Published online by Cambridge University Press

Cuvier, who opened his *Ossemens* with the Pachydermata, the Proboscidae. Falconer wrote: "following our illustrious guide in extinct zoology, we shall commence with the Elephant group, in which is most signally displayed the numerical richness of form which characterizes the Fossil Fauna of India" (Falconer 1846). The description of Pachydermata begins interestingly with an allusion, this time, to the "false beliefs" of the natives and the role played by western science in dispelling these:

> Like the Greeks and Romans of old, the people of India even now, usually refer such remains to the Rakshas or Titans, who hold so prominent a place in the ancient writings of that country. The severe investigation of modern science, have expelled these fictions for the belief of civilized mankind, and reconstructed the true forms of the animals, which appear in many instances to have given rise to them. Palaeontology made, as it were, its first great advance in the exact determination by Cuvier of the mammoth of Siberia, and the Mastodon of North America. (Ibid.)

Very keen that the specimens displayed in the Museum should prove instructive to the public, Falconer, as early as 1844, discouraged casts of fossils being taken in plaster because it concealed many of the important characteristic details. He claimed that it "precluded the power of examining the specimen in detail – a point of great importance in a scientific view – more especially in regard to an animal so extraordinary as the Gigantic Tortoise." Thus, he suggested to Konig that it was best to display the specimens of the *Colossochelys* in cases and have life-size wood or cement models, which would make

> the specimens intelligible to the public or useful as objects of Exhibition in the National Museum – considered apart from their mere scientific value. . . . Fancy what a grand object this would make in our National Museum – with the Mastodon of America at one end of the series – and the Indian Colossochelys at the other. If room could not be found for such a model in the Mineralogical dept. Rooms, it might be fitly placed on the landing place at the top of the staircase at either end and there stand as a sort of Gentleman usher in the Tortoise way – to the imagination in regard to the wonder of the gallery within – and with the mastodon together our Museum would be unrivalled in Europe as to objects of this character and without such a model, the specimens of the Colossochelys will in a great measure be lost to the public – and the Museum deprived of a stupendous and easily attainable ornament.[44]

Falconer thought that the artist Scharf, who had made a full-sized drawing of the Giant and was trained in the art of modeling in wood, would answer well for the job at hand. And in the case of the British Museum Trustees entertaining a restoration project, Falconer suggested that a committee be appointed consisting of his friend Owen and Thomas Bell of New Broad Street who were the best living authorities on Tortoises.

[44] NHM: DF 105/14, letter dated April 3rd, 1844.

For the extraction of the organic remains from the rock matrix at the India House, Frederick Pullman and two stone-cutters were employed in 1845 as per the Court's orders. Though Pullman's regular employment was to be terminated in June 1846, Thomas Horsfield, the Librarian at the India House, pushed a request for his services to be extended in order to accomplish the important task of taking casts because

> [Falconer had reconstructed a series of fossil specimens] which the Geologists of Europe will appreciate and be compelled to refer to, from their absence from the Cabinets of the Continent or the British Museum. Nevertheless the series is not complete and gaps can only be filled up by casts of specimens from the Continental Collections or from the British Museum, but these casts can be most readily obtained by an interchange of casts for the Company's rare specimens.[45]

Horsfield assured the Court of Directors that Pullman had already proved his talent in making casts. Moreover his employment cost only one-fourth of the amount required to employ professional artists. His services were also essential in the completion of the vertical section of the teeth of the different species, which would be very expensive if professional lapidaries were hired (ibid.). Horsfield's proposal was finally approved of and Pullman's employment was extended for the purpose of reproducing fossil specimens.

At the end of 1847 Falconer, whose period of stay in England was drawing to a close, acquainted the Court of Directors with the progress in his work on the Siwalik fossil collection which would culminate in the publication of the *Fauna Antiqua Sivalensis*. The contents of upwards of 200 chests had been spread out, repeatedly examined, and the "refuse" material displayed in the enclosed garden on the west side of the Museum building. Falconer had left it to the Trustees to decide how this part of the collection was to be disposed of. Nevertheless, he sounded out his own opinion in this regard. Since the material was unfit for use or display in the Museum, he suggested they be distributed among leading provincial Museums "in the three Kingdoms" and among the chief metropolitan institutions abroad. Falconer was quick to add that his friend and colleague Cautley in India was agreeable to this suggestion. However, until they were ready to be distributed, he warned, they were to be protected from frost as otherwise "they would disintegrate from the freezing of imbibed moisture," a condition that it was subjected to during the previous winter.[46] If a "heterotopia" refers to a single real place where several spaces that are in themselves incompatible are juxtaposed such as museums, libraries, and laboratories (Foucault 1967), what does one call a single person who can navigate between several kinds of spaces? Falconer was one such, navigating

[45] BL, IOR: L/F/2/101, letter dated July 4th 1846. For a list of fossil remains selected from the Museum of the East India House, as desiderata to the British Museum (prepared by George R. Waterhouse); and a list of fossil remains of elephants, being mostly specimens figured in Falconer's *Fauna Antiqua Sivalensis*, see NHM: DF 105/36.

[46] NHM: DF 100/6, letter dated British Museum, Dec. 3rd 1847.

with ease between various spaces – the field, the lecture theatre, the museum, the colony, the metropolis; between disciplines – botany, geology, and zoology; and also between practice and theory.

Pullman's colored fossil casts were sent to the University collections at Cambridge, Oxford, and Edinburgh in 1849. The Imperial Academy of Sciences at St. Petersburg and the Danish government also wrote to the India House for casts. Soon casts were exchanged with museums the world over including the newly formed Museum of the Geology in India, in return for Siwalik fossil casts lacking in its own collection. Colored sets of casts in six cases were also shipped on the Edendale in 1856 to the Calcutta Medical College.[47] Richard Lydekker's catalogue (1885–86) of the Siwalik fossils in the museum of the Geological Survey of India, published more than three decades later, was in a position to claim that its museum contained types even unknown to the British Museum. Its collections of Siwalik fossils included a series of casts presented to the Museum of the Asiatic Society of Bengal, Calcutta, by the Court of Directors in the 1840s, another series purchased as late as 1878 and 1882 from the British Museum and a few purchased from the Royal College of Surgeons, London in as late as 1881.[48] In 1879, Lydekker had exchanged original teeth and bones of about twenty species of Siwalik mammals from the Cautley-Falconer collection, for the fine carapace of an Emyda in the Museum of Comparative Anatomy, Cambridge,[49] bought at a sale in London by Prof. Adam Sedgwick.[50] Even as late as 1907, Siwalik fossils appeared at a sale in Cambridge. The lot included the molar teeth of a Mastodon *Elephas*, which Dr. J. W. Clarke of the Museum of Comparative Anatomy in Cambridge had given for "safe-keeping" to H. Latham, the Tutor of Trinity Hall "years ago"! The Tutor had decided to put them up for sale at his house and advertised them under the title, "Three Ornamental Shells and Twenty Geological Specimens." The fossils were purchased and acquired once again by the Cambridge Museum.[51] The *Fauna Antiqua Sivalensis* was however never completed, and with Falconer's death in 1865, the scientific world realized in utter disappointment that little had been left behind of the vast and significant amount of research Falconer had accomplished in both India and England.

Concluding Remarks

This colonial palaeontological episode demonstrated that the heterogeneous nature of the science of Siwalik palaeontology involved the cooperation of the Doab Canal

[47] BL, IOR: F/4/2636 no. 167423.
[48] See Falconer 1859, for a descriptive catalogue of the specimens in the Asiatic Society of Bengal.
[49] University Museum of Zoology, Cambridge (Archives), Vol. H, II, ff. 220–21, letter dated Ladak, Aug. 2nd, 1879 and Calcutta, Nov. 7th, 1879.
[50] E. 163 in Lydekker (1886), Part II.
[51] University Museum of Zoology, Cambridge (Archives), Vol. H, VI, f. 140.

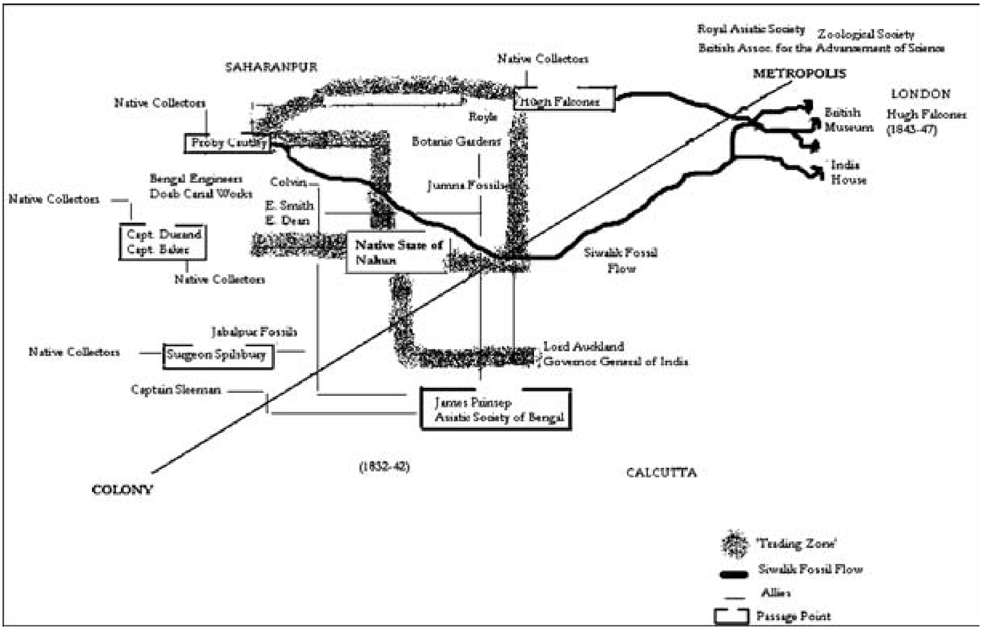

Fig. 5. Mapping the Field: "Passage Points" and "Trading Zones."

engineers, the surgeon-botanists at the Saharanpur Botanic Gardens, other colonial officials, the native State of Nahun, and the native collectors, to all of whom the Siwalik Hills was a "boundary object" (see fig. 5). If the historical narrative began with the Asiatic Society of Bengal in Calcutta as the original "obligatory passage point" engaged in "translations" with "allies" operating in the vicinity of the Hills, towards forming a collection in the Society, it moved on to a private collection of fossils formed by Cautley, in the process of being transported to London under the patronage of the colonial Government and the metropolitan museum. The second part of the story had Falconer playing the main part; we see him communicating his discoveries to the metropolitan scientific societies, lobbying for funds, curating, "crafting" and finally preparing a catalogue of Siwalik fossils.

An original "obligatory passage point" had led to the production of other "passage points," all negotiating simultaneously with their "allies" towards achieving not only the original goal but also newly invented ones. Successful partnerships were also struck up between strong "allies" like Durand and Baker and between people as different in their visions as Cautley and Falcon.

If Cautley the engineer was a field worker through and through, Falconer the surgeon could negotiate and "translate" between various epistemic spaces ranging from the field, the laboratory, the museum and the lecture theatre. The two were able to cooperate despite the difference in their visions of what science should be by virtue of being connected by a "trading zone"; Cautley owned the most extensive and rich collection of Siwalik fossils and Falconer had the tools required to make sense of it both geologically and zoologically.

In the context of discovery of fossils in the colony, heterogeneity worked as a factor of strength rather than a deterrent, for we find hardly an instance where a "passage point" determines standards to discipline collecting processes. Collecting did not require a new set of "translations" as official colonial networks already in place were exploited for the purpose. "Translations" were effected also through the invention of a nomenclature that recognized other social worlds and through the invocation of the "original" discoverers irrespective of whether they were aware of the significance of their discovery, and however distant in time they may be. That the processes of collecting influence the making of science is evident from Falconer's thesis, an act of "translation" that was inspired by the locality of the collection.

References

Aiken, John and Anna Barbauld. 1792–96. *Evenings at Home: Or, The Juvenile Budget Opened*. 6 Vols. London.

Asiatic Society of Bengal. 1885. *Centenary Review of the Asiatic Society of Bengal from 1784–1883*. Calcutta: Asiatic Society of Bengal.

Brockway, Lucile H. 1979. *Science and Colonial Expansion: The Role of the British Royal Gardens*. New York and London: Academic Press.

Brown, Joyce. 1978. "Sir Proby Cautley (1802–71), a Pioneer of Indian Irrigation." In *History of Technology*, edited by A. R. Hall and N. Smith, vol. 3, 35–89. London: Mansell.

Callon, Michel. [1986] [1998] 1999. "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St. Brieuc Bay." In *The Science Studies Reader*, edited by M. Biagioli, 67- 83. New York and London: Routledge.

Cautley, Proby. 1853. *Memoranda on Irrigation by Rajbuhas*. Roorkee.

Crauford, John. 1829. *Journal of an Embassy from the Governor-General of India to the Court of Ava in the year 1827*. London: Henry Colburn.

Drayton, Richard. 2000. *Nature's Government: Science, Imperial Britain and the 'Improvement' of the World*. New Haven and London: Yale University Press.

Eden, Emily. 1844. Portraits or Princes and the People of India. London.

Falconer, Hugh. 1846. *Fauna Antiqua Sivalensis, being the Fossil Zoology of the Sewalik Hills in the North of India*, Pt. 1. London: Robert Hardwicke.

Falconer, Hugh. 1859. *Descriptive Catalogue of the Fossil Remains of Vertebrata from the Sewalik Hills . . . in the Museum of the Asiatic Society of Bengal*. Calcutta: C. B. Lewis.

Foucault, Michel. 1967. *Of Other Spaces, Heterotopias*. http://foucault.info/documents/heteroTopia/foucault.heteroTopia.en.html.

Fujimura, J. H. 1992. "Crafting Science: Standardized Packages, Boundary Objects, and 'Translation'." In *Science as Practice and Culture*, edited by A. Pickering, 168–211. Chicago: University of Chicago Press.

Galison, Peter. [1997] [1998] 1999. "Trading Zone: Coordinating Action and Belief." In *The Science Studies Reader*, edited by M. Biagioli, 137–160. New York and London: Routledge.

Golinski, Jon. 1998. *Making Natural Knowledge: Constructivism and the History of Science*. Cambridge: Cambridge University Press.

Gooding, David, Trevor Pinch, and Simon Schaffer, eds. 1989. *The Uses of Experiment: Studies in the Natural Sciences*. Cambridge: Cambridge University Press.

Grove, Richard. 1995. *Green Imperialism: Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600–1860*. Cambridge: Cambridge University Press.

Kejariwal, Om Prakash. 1988. *The Asiatic Society of Bengal and the Discovery of India's Past, 1784–1838*. Oxford: Oxford University Press.

Knell, Simon. 2000. *The Culture of English Geology, 1815–51: A Science Revealed through its Collecting*. Aldershot: Ashgate.

Kuklick, Henrika and Robert E. Kohler. 1996. "Science in the Field." *Osiris* (2d ser.) 11(2):1–13.

Kumar, Deepak. 1995. *Science and the Raj, 1857–1905*. Delhi: Oxford University Press.

Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, MA: Harvard University Press.

Lydekker, Richard. 1885–86. *Catalogue of the Remains of the Siwalik Vertebrata contained in the Geological Department of the British Museum*. Calcutta. 2 Vols.

Middleton, J. 1844. "On fluorine in bones, its source, and its application to the determination of the geological age of fossil bones." *Proceedings of the Geological Society* 4:431–3.

Miller, David Phillips. 1996. "Joseph Banks, Empire and 'Centres of Calculation' in Late Hanoverian London." In *Visions of Empire: Voyages, Botany, and Representations of Nature*, edited by D. P. Miller and P. H. Reill, 21–27. Cambridge: Cambridge University Press.

Morell, Jack and Arnold Thackray. 1981. *Gentlemen of Science: Early Years of the British Association for the Advancement of Science*. New York: Oxford University Press.

Murchison, Charles. ed. 1868. *Palaeontological Memoirs and Notes of the Late Hugh Falconer*. 2 Vols. London: Hardwicke.

Pang, Alex Soojung-Kim. 2002. *Empire and the Sun: Victorian Solar Eclipse Expeditions*. Stanford: Stanford University Press.

Porter, Roy. 1978. "Gentlemen and Geology: The Emergence of a Scientific Career." *Historical Journal* 21:809–36.

Rudwick, Martin. 1976. *The Meaning of Fossils: Episodes in the History of Palaeontology*. New York: Science History Publications.

Rudwick, Martin. 1985. *The Great Devonian Controversy: The Shaping of Scientific Knowledge among Gentlemanly Specialists*. Chicago: University of Chicago Press.

Sangwan, Satpal. 1991. *Science, Technology and Colonisation: An Indian Experience 1757–1857*. New Delhi: Anamika Prakashan.

Schumaker, Lynette. 1996. "A Tent with a View: Colonial Officers, Anthropologists, and the Making of the Field in Northern Rhodesia, 1937–60." *Osiris* 11(2): 237–258. Chicago: University of Chicago Press.

Secord, Ann. 1994. "Science in the Pub: Artisan Botanists in Early Nineteenth-Century Lancashire." *History of Science* 232:269–315.

Star, Susan Leigh and James Griesemer. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies in Science* 19:387–420.