

MEMOIR,

BY

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ON THE

FOSSIL REMAINS,

PRESENTED BY HIMSELF

AND

COLONEL COLVIN, C. B.,

TO THE

Museum of Natural History,

AT LUDLOW.

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LUDLOW:

PRINTED BY E. J. PARTRIDGE, LIBRARY, BROAD - STREET.

PRICE SIXPENCE.



# MEMOIR.

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THE organic remains lately presented to the MUSEUM OF NATURAL HISTORY at LUDLOW, and labelled "SEWALIK FOSSILS," were obtained from a low range of hills lying at the base of the S. W. slope of the Himalaya Mountains, between the rivers Jumna and Sutlej; about N. lat.  $31^{\circ}$  and E. long.  $77^{\circ}$ , and varying in height from 1,200 to 2,000 feet above the level of the sea.

The strata in which these fossils occur are alluvial in their nature, and would be classed by Geologists with the upper tertiary formations. I call them "alluvial in their nature," for they have evidently, been deposited by the action of land floods, have never been overlaid by other formations, and where con-

solidated into stone, the induration has been effected by the infiltration of lime, and not by heat or pressure. They have, however, been disturbed from their original horizontal position, and are found at angles of elevation, varying from  $60^{\circ}$  to  $0^{\circ}$ . Consisting of matter transported by the action of flowing water, they exhibit great variety of structure from beds of large boulders (or rounded stones) to pebbles, gravel, sand, and fine mud or clay. The boulder deposits are very extensive, so much so, as to give a character to the hills in which they occur, and which have been by some called the "Boulder Range." The fossils, however, are found chiefly in the finer strata of mud or sand, and this might be expected from the analogy of existing rivers which deposit the carcasses of animals brought down by the currents, not on their stony rapids, but in the comparatively still waters near their debouchure, into a lake, or the sea.

The fossilizing matter, or that which replaces the animal substance in the bones &c., is in some cases hydrated oxide of iron, but more generally carbonate of lime. The organic

remains are frequently the nuclei of large nodular concretions of calcareous sandstone, very hard and compact, originally imbedded in the softer strata, but having resisted the action of the rains by which the latter are gradually disintegrated—they now remain lying on the hill-sides, or in the ravines and watercourses.

Fossils similar, and in some cases I believe, identical with those met with in the Sewalik Hills, have been found in very distant parts of the Sub-Himalayas, from the banks of the Irawaddy in Burma, in N. lat.  $23^{\circ}$ , E. long.  $95^{\circ}$ , to the Punjaub, N. lat.  $33^{\circ}$ , E. long.  $73^{\circ}$ .\* Nor are they confined to the south-west slope of these mountains. Fossils nearly identical with those of the Sewaliks, have been found on an elevated plateau 15,000 feet above the level of the sea, north-east of the Snowy Range; and the similarity of the strata in which they occur, as well as that of the organic remains, has led some observers to the conclusion, that

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\*Fossils somewhat similar to these have been found in the Jumna, near Kulpee, in Bundelcund, and on the Perim Island, off the Coast of Guzerat; but being geographically disconnected from the Himalayan deposit, they need not be further noticed here.

these formations were once continuous, and that they existed before the elevation of the great granite ridge of the Himalayas now lying between them, and crowned with some of the loftiest peaks on the surface of the globe. The absence of granite boulders and pebbles from these alluvial deposits, contrasts strongly with the large proportion of primary rocks, found in the beds of rivers now draining the Himalaya; and certainly admits of the inference, that the mountains, from whose debris the strata under consideration were formed, did not contain granite; and therefore were not the existing Himalayan chain.

Admitting even the possibility of the truth of this hypothesis, one cannot help looking with some reverence on the remains of animals, that may have eaten and drank, and played their part on the world's stage, while the subterranean forces were yet dormant, which subsequently shot up more than five miles into the air, and far beyond the limits of animal or vegetable life — those snow-clad summits, and granite pinnacles which overtop even the Andes.

Apart from the light which the Sewalik fossils are calculated to throw on the geology of India, they present matter of deepest interest to the Palæo-zoologist. The existing forms of animal life, at least, as regards the larger vertebratæ, had been already investigated, and naturalists were beginning to sigh for new worlds to explore. When geology unfolded her annals of former ages, and displayed to their enquiring gaze the remains of past existences, preserving amidst an endless variety; the uniform stamp of an all-wise and beneficent Creator's hand. Such records are indeed inscribed in characters, which at first sight may appear obscure; but comparative anatomy has supplied a key to the alphabet. An intelligent observer examining the forms and structure of existing animals, will find a certain harmony and adaptation of the parts of each to its habits of life; and though we cannot affirm that a given end is always attained by the same means, (for there is an infinite diversity in the operations of nature), yet, the same or similar means being employed; we can with more confidence infer that an

analogous object was intended to be served. *Eating* is the great business of life among the brute creation, and accordingly we find, that the teeth are the parts of their skeletons most characteristic of their habits of life. Thus, with teeth suited for tearing and dividing flesh, we find limbs adapted for the pursuit and capture of prey : with teeth proper for the mastication of grass and tender herbage, we find associated the means of flight or defence ; which enables their possessors to escape for a time from the fangs of those carnivorous animals whose natural prey they are : the huge grinders, suited to crushing sticks and boughs of trees, are found in connection with strength and proportion of limb necessary for reaching and obtaining that description of food. The teeth, in fact, may be said to regulate the skeleton ; take for example those of the elephant, consisting of grinders, such as have been just been described, and a pair of massive ivory tusks. The weight of such an apparatus at the end of a long lever would be insupportable ; and we accordingly find, that the neck is shortened in a remarkable degree,



the seven cervical vertebræ being compressed into what may be called osseous plates compared with similar bones of other animals. A considerable length of limb is also needful, to raise this massive head from the ground, and to prevent an unsightly disproportion between the height and necessary thickness of the leg; but a mouth elevated from the ground, and attached to a short and stiff neck, would be unable to obtain its food and water; and the difficulty is met, by that which is a nose in other animals being, in the elephant lengthened out into a powerful and flexible tubular arm, capable of grasping and carrying food to the mouth, and of containing and raising water.

Again, the thickness and solidity of a bone, affords evidence of the element in which its quondam possessor once moved. The winged inhabitants of the air have a skeleton consisting of light hollow tubes, or thin plates of bone. The crocodile and other aquatic reptiles, whose weight is supported chiefly by the dense element in which they live, have heavy and solid bones. While those of terrestrial quad-

rupeds, occupy a middle place between these two extremes. Such illustrations could easily be multiplied, but leaving the more general question, I will at once proceed to enumerate some of the principal genera of extinct animals which have left their remains in the Sub-Himalayan strata, and to state some of the inferences which may be drawn from thence, regarding the nature of the country which they once inhabited.

I will then give some account of that extraordinary animal, the Sivatherium, of whose remains there are such beautiful casts, as well as some actual fossils in the Ludlow Museum.

## Pachydermata.

Under this class we have, the *Mastodon*, represented by two species, the *Angustidens* and *Latidens*; of which the former is found in a fossil state, in America and Europe.

The *Elephant*, of which there are several species, some of which, closely approach the existing forms now met with in Asia and

Africa; while others exhibit marked differences from the known types—a cranium with a pair of tusks—of *elephas primigenius*, presented by me to the British Museum, is the largest ever discovered.

The *Hippopotamus* has two fossil species, distinctly differing in the number and form of the teeth from its congeners of the present day. One of these was a small and slender animal, very unlike in external form, the uncouth monsters which now wallow in the mud of the African rivers.

Of the *Rhinoceros*, there may be one or two species, but they differ little from each other, or from the Indian one-horned rhinoceros, except in size. A fossil specimen of which, there is a cast in the Ludlow Museum, is considerably larger than the cranium of the existing rhinoceros.

Of the *Boar*, (*sus*), and allied genera, there are several varieties, generally resembling in structure and not exceeding in size the existing types. In addition to the above, there are many extinct genera of *pachydermata* not represented in the animal kingdom of our

times ; but having many analogies with some of the fossil animals discovered by Cuvier, in the Paris basin, and called by him Palæotherium, Anoplotherium, Anthracotherium, &c., &c.

Of the *Solipeda*, or *Solidungula*, comprising only the genera *equus*, we have several species differing in the flexures of the enamel of the grinding teeth ; but in size and form, closely resembling the horse, zebra, quagga, ass, &c., of the present day.

## Carnivora.

Of the genus *Felis*, we have several varieties, chiefly distinguished by size, which varies from that of the lion and tiger to that of the wild cat. The forms differ little from the recent types, except in one instance, where the back or molar teeth are more adapted for cutting, and the jaw has less lateral or grinding motion than that of the existing *felis*, which, itself, has these peculiarities in a greater degree than any other carnivorous animal. The species above referred to, has I believe,

been taken out of the genus "*felis*," but by what new name it is designated, I cannot at present recollect.

Of the *Hyena*, there are two or three distinct species, one of them very large—all resembled the present species in their habit of gnawing bones, as is proved by the worn state of their teeth.

Of the *Canis*, we have specimens of wolves, jackals or dogs, and foxes, differing little from the existing representatives of these species.

Of the *Ursus* or bear, there are at least two distinct species, one of them closely resembling the black bear of Upper India, another of a size exceeding that of any fossil or recent species hitherto known.

We have remains also, of the otter, weasel, ratell, ichneumon, and one or two animals not to be identified with existing forms.

### Quadrumanæ.

The four-handed or monkey tribe, was long a desideratum in fossil geology, and learned arguments were not wanting to shew

the unfitness of the former world for the existence of animals of so high a type of organization. Time, however, which upsets so many theories, disclosed the existence of fossil quadrumanous remains, in three quarters of the world at once, and the site of one of these deposits was in the Sewalik Hills—the specimens are comparatively few, but we have indications of two or three species, one of them an ape, that probably stood upwards of six feet high.

### Ruminantia.

The ruminants of these ancient kingdoms of nature, like those of the present order of things, are more numerous than any other tribe, and indeed all the rest put together; they comprise some unknown genera, in addition to nearly all of those with which we are now familiar.

After the *Sivatherium*, which (in pursuance of the plan already announced) will be separately noticed hereafter; next in order of the large ruminants, we have the *Elk*, of

which palmated horns and cervical vertebræ have been sparingly discovered.

Of the *Giraffidæ*, or animals allied to the camelopard, there is one distinct species and traces of others.

Of the *Camel* there are two species resembling in form and size their existing congeners.

The *Bovine* or *Ox* tribes are largely represented in these deposits, from the size of the urus, bison, and buffalo, down to that of the Highland cattle; they exhibit a great diversity, in the form and development of the horns, and in the shape and proportions of the frontal and occipital bones.

The *Cervus* or *Stag* has left us many specimens of its branching antlers and peculiar form of molar teeth, but its species are not nearly so numerous as those of the antelope, which must have swarmed on those ancient plains as thickly as they now do in the undisturbed parts of southern Africa: some of the fossil species in their elongated facial bones, the form of their horns, and the position and development of their lachrymal sinus, bear a strong resemblance to the hartebeest (*acronotus*

*caama*), and the sassaybe (*acronotus lunata*), described by travellers and sportsmen of the Cape Colony.

### Rodentia.

Two genera, the *Porcupine* and *Rat*, represent the numerous tribes of gnawing animals which now inhabit the earth, but the infrequency of their occurrence in the fossil deposit, is no proof that they were not more numerous when in life; the habits of such animals as well as the smallness of their bones are alike unfavorable to the preservation of their remains in a fossil state.

### Aves.

The remains of birds have been found in the Sewalik strata, but they are of rare occurrence and consists of bones of grallæ or waders, and of a large kind of swan.

### Reptilia.

In strata evidently the result of the action of fresh water, the remains of aquatic and



amphibious animals may naturally be looked for, nor will this expectation be disappointed in the Sub-Himalayan formations. Of the *Crocodile* we have three distinct species, and probably more: two of them closely resemble respectively, the muggur or true crocodile of the Ganges, and the ghurial or leptorynechus: the third, which greatly exceeds the others in size, appears to be intermediate between them in the proportions of its parts. One of the casts in the Ludlow Museum, [presented by Colonel Colvin, exactly represents part of the snout of one of these immense reptiles, and will give some idea of what must have been the size of the entire skeleton,

Of the two kinds of *Tortoise*, (*emys* and *trionix*), we have met with many and some very perfect specimens, but so numerous are the varieties of existing tortoises, so wide their distribution, and so difficult to obtain, that an accurate comparison of the fossil and recent species will be a work of time and labor. There is one fossil species, however, not likely to be confounded with any existing type, it is of a gigantic proportion, the humerus or

shoulder bone being as large as the corresponding part of a rhinoceros, and the diameter of its shell has been computed at about sixteen feet; it has been called "*Colossochelys atlas*."

Of the *Batrachian* tribes, (*toads and frogs*), of which the bones are slight and brittle, one specimen only has yet found a place in our collections. It is a tolerably perfect specimen of a large frog. It appears to have had some affinities with the *rana esculenta*, but if it resembled that animal in the quality of its flesh, its dimensions would have rendered it a valuable acquisition to an antediluvian larder. It is computed to have been three feet and a half in length from the snout to the bifurcation of the hind legs.

### *Fishes.*

The species of fossil fish found in the Sub-Himalayan deposits are less numerous than might have been expected, some specimens have, however, been met with, but have not, as far as I know, been examined or described by a competent lithyologist.

## Mollusca.

Fluviatile and lacustrine shells, both bivalve and univalve, occur abundantly in one or two localities, some of them have been identified with genera now existing in the rivers and ponds of India.

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Having now concluded my list of the principal genera which constitute the ancient Fauna of the Siwalik strata, it remains to notice the great variety which exists in the *age* of the animals whose remains have thus strangely fallen into our hands. Many of the teeth exhibit the first or deciduous form; most of them belonged to individuals in the prime of life; and comparatively few are sufficiently worn to justify the inference that their possessors died of old age: nor does this remark apply only to animals which being the natural prey of others are more subject to an untimely death, it is equally true of the larger *pachydermata*, the *sivatherium*, and even of the *carnivora* themselves. It may be further observed that the genera are such as may be

now met with in warm climates, and that we have nowhere found a trace of marine remains.

On reviewing the list of animals above enumerated, and which perhaps bear but a small proportion to those intombed in the yet hidden strata, one cannot help wondering what combination of circumstances could have gathered into a comparatively small space, as into a common cemetery; the remains of creatures differing so widely in their forms and habits, and in their adaptation to particular localities.

It will meet most of the conditions of the case before us, if we suppose that the strata now constituting the Sub - Himalayan Range between the Jumna and the Sutlej, were deposited on the margin of an inland lake, or fresh water sea, at the debouchure of a river which had collected in its course, the various spoils of a tropical continent, resembling in its physical conditions the southern regions of Africa. Such a country would supply forests and savannahs for the elephant and rhinoceros, &c.; deserts and barren plains for the wild ass and the camel; mud-banks and sluggish

streams for the crocodile and hippopotamus ; boundless prairies with scattered trees for the giraffe, and for the troops of wild horses and antelopes, as well as for the larger feline animals that preyed upon them. We must further suppose that this continent was subject to occasional devastations, perhaps from the effects of volcanic agency, but more probably by floods which periodically overwhelmed the land, carrying with them the inhabitants of the plains, and burying old and young—spoiler and spoiled alike—in the gravel and soil swept along with them in their headlong course. The wide distribution of the fossils, extending through at least thirteen degrees of latitude, and twenty-two of longitude, would prove the extent of the Continent, but it is not supposed that the fossils are equally diffused throughout the whole of this space ; they occur for the most part in separate deposits, each of which owed its origin to a separate though probably analogous combination of circumstances.

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The *sivatherium* appears to have supplied an important link between the *ruminantia* and

the *pachydermata*; its peculiar and grotesque form (as illustrated by the specimens in the Ludlow Museum), and its great divergence from any known type, seems to entitle it to a more detailed notice than could have been properly introduced in the general catalogue which I have given above.

The fossil cranium of the *sivatherium*, of which a very perfect cast has been presented to the Ludlow Museum by Colonel Colvin, was the first, and for some time the only specimen of the genus discovered in the Siwalik Hills. It was however so perfect as to form the subject of a very interesting notice by the discoverers Dr. H. Falconer, and Colonel P. T. Cautley, in which they not only described the portions of the skeleton which were before them, but inferred with an accuracy tested and proved by subsequent discovery, the form of those parts which were then deficient.

The character of the teeth, and the presence of bony horns\* are sufficient proof that the animal was a ruminant, but in other respects

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\*It is perhaps hardly necessary to observe, that the horn of the rhinoceros (the only animal not a ruminant that has the resemblance of such a weapon) is not a true horn, but a dermal appendage of the nature of hair.

it has little resemblance to any of the known genera of that order. The great size approaching that of the elephant, the immense development and width of the cranium behind the orbits; the two divergent osseous cones for horns starting out from the brow between the orbits; the form and direction of the nasal bones rising with great prominence out of the chaffron, and overhanging the external nostrils in a pointed arch. The great massiveness, width, and shortness of the face forward from the orbits, and the great angle at which the grinding plane of the molars deviates upwards from that of the base of the skull, are some of the most remarkable external peculiarities of the head. The orbit is considerably smaller in proportion to the size of the head than in existing ruminants; it is also placed more forward in the face, and lower under the level of the brow: the rim is not raised and prominent as in the *ruminantia*, and its plane is oblique, the longitudinal diameter exceeds the vertical in the ratio of five to four nearly. From these characters it was inferred that the eye was smaller and less prominent than in

existing ruminants, and that the expression of the face was heavier and more ignoble; that the direction of vision was considerably forward as well as lateral, and that it was cut off towards the rear.

The structure of the bone of the skull, as shewn by a fracture in the fossil, is unprecedented in a ruminant, it consists of an outer and inner plate connected by cells, as in the elephant; the interval between the plates exceeds two inches and a half in the occipital region. This peculiarity, which is adapted for supplying an extensive surface for muscular attachment, and the lateral expansion of the occipital into alæ (or wings), led to the conclusion that the head must have been of great weight, and the neck short, thick, and fleshy, with a limited range of motion: the weight was supposed to be increased by a posterior pair of horns in addition to the anterior ones already adverted to: a conjecture which was subsequently verified in a striking manner, in the discovery by Colonel Colvin, of a fragment (a cast of which was presented by that gentleman to the Ludlow Museum), shewing



distinctly the bases of the four horns, of which the posterior pair were branched and palmated like those of the elk, and the anterior were short and conical, having an osseous core covered with a horny case, as in the bos and antelope.

The shortness and stiffness of the neck, leading as in the elephant, to the necessity of some extraordinary expedient for supplying the mouth; the form of the nasal bones, and the great size of the infra-orbital foramina for the transmission of nerves to the upper lip, indicate the probable existence of an organ resembling the trunk of an elephant; and though this conjecture can never, like the other, be actually verified, it is too strongly supported by obvious analogy to admit of much doubt.

In the foregoing remarks on the *sivatherium*, which are abstracts from an article published by Dr. H. Falconer, and Colonel P. T. Cautley, in the Journals of the Asiatic Society of Bengal, I have gone into greater details than appeared necessary when describing the other fossils, most of which may be referred to known genera.

It may however, be borne in mind, that few, if any of the fossil species are exactly identical with those of the present day, though in some cases, the variations of structure which constitute specific differences are too minute to strike a casual observer.

W. E. Baker.

LEINTWARDINE,  
SEPTEMBER 12, 1850.

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B. J. PARTRIDGE, PRINTER, BROAD - STREET, LUDLOW.