

IV.—*A Sketch of the History of the Fossil Vertebrata of India.*—
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As far as I am aware, there has not hitherto been written a complete history of the whole Fossil Vertebrate Fauna of India, as far as it is at present known to us, and I have, therefore, thought that it may interest many members of this Society, as well as others, to know something of the extent and affinities of this fauna, without the labour of wading through the various works in which its history is recorded. The history of the Fossil Vertebrata of India is, indeed, intimately connected with this ancient Society, since some of the earliest workers in this branch of enquiry were formerly among its members, and many of the results of their labours are to be found scattered through its earlier records. Pre-eminent among those workers will always stand out the names of Baker, Durand, Cautley, Colvin, Falconer, Hislop, M'Clelland, and Spilsbury. And it must always be remembered, to their honour, that these workers in this most interesting department of palæontology were solely amateurs, and that in their time the study of vertebrate palæontology in this country was encumbered with difficulties of which we, at the present day, can have no adequate conception. The labours of Mr. Hislop were mainly expended in searching the Gondwána rocks of the Central Provinces, from which he obtained many interesting remains of reptiles, batrachians, and fishes ; Col. Sykes' collections were chiefly made among the fossil fishes of the Deccan ; while the field of labour of the other workers lay mostly among the mammaliferous beds of Northern India, and the Narbada (Nerbudda) valley.

I very much regret to say that since these illustrious workers, no amateurs in India seem to have entered upon this interesting field of research, and during the five years which I have been upon the staff of the Geological Survey of India, we have not, I believe, received, in the Indian Museum, a single fragment of a fossil vertebrate from a non-professional worker. It is partly in the hope that this paper may reach the eye of amateurs interested in natural science, and especially of those who lead a wandering life in India, and induce them to endeavour to collect specimens of vertebrate fossils for the Indian Museum, that it has been penned.

Apart from members of the Geological Survey of India, to whom I shall refer presently, there are other workers who, though not members of this Society, have contributed largely to the history of the extinct verte-

brate life of India. Noticeable among these are the names of Buckland, Crawfurd, and Clift. Crawfurd, on his return from his mission to the court of Ava in 1826, brought back some Tertiary mammalian remains from the valley of the Irawadi, which were among the first obtained in Asia by Europeans, and which were subsequently described by the late Mr. Clift in the 'Transactions of the Geological Society of London.'* In the same volume of the 'Transactions,' a memoir was also published by the late Dr. Buckland on the Ava bones. Another memoir also appeared in the same volume by Mr. Pentland, on certain mammalian remains from the Siwaliks of Sylhet, collected by Sir T. Colebrooke. As you are doubtless aware, the fossil vertebrate fauna of the Siwaliks and the newer Narbadas, were subsequently fully illustrated, and in part described, by our former illustrious associates, Falconer and Cautley, the results of whose labours are abundantly dispersed through our Society's publications, and displayed in that now classic work the 'Fauna Antiqua Sivalensis.'

Dr. Charles Murchison, the editor of the 'Palæontological Memoirs' of Dr. Falconer, has rendered one of the most important services to the cause of vertebrate palæontology in this country, by collecting and publishing the scattered notes and memoirs of that distinguished palæontologist. Professors Owen and Huxley have contributed largely to our knowledge of the fossil Reptilia and Batrachia of India; while the fossil fish have been enriched either by the discoveries or the writings of Messrs. Egerton, Miall, Sykes, and Walker.

A valuable memoir on the extinct Siwalik genus *Sivatherium* was contributed to the 'Geological Magazine' by Dr. Murie; another on *Bramatherium*, by Mr. Bettington and Professor Owen, to the 'Journal of the Royal Asiatic Society.' A few Siwalik fossils collected by the Messrs. Schlagintweit were described in the German 'Palæontographica' by the late H. von Meyer. The late Dr. J. E. Gray also determined a few of the Indian fossil reptiles. Professor A. Milne-Edwards determined some Siwalik bird-bones. Some mammal-bones from the Tibet Tertiaries were determined by Mr. Waterhouse.

Among the later contributors to our knowledge of the fossil vertebrata of India must be mentioned Professor Rüttimeyer, who has afforded valuable information on the Siwalik ruminants in the British Museum; and Mr. P. N. Bose, who has described some of the fossil Siwalik Carnivora in the same collection. Mr. Davies, of the British Museum, has also contributed to the 'Geological Magazine' a valuable paper on Siwalik birds. Professor Leith Adams has published some notes on *Elephas namadicus* in the Palæontographical Society's publications.

The above names are only the chief among the workers in Indian

* Ser. 2, Vol. II.

vertebrate palæontology who are unconnected with the Geological Survey of India. Of the former or present officers of that department, I must mention, among discoverers, the names of Messrs. W. T. and H. F. Blanford, Fedden, Foote, Hacket, Hughes, Medlicott, Theobald, Tween, and Wynne, and, among writers, Messrs. W. T. and H. F. Blanford, Foote, Oldham, Stoliczka, Theobald, Waagen, and, lastly, myself.

Minor contributions, in the way both of specimens and papers, have been made by other gentlemen, all of whose names it would be both tedious and difficult to bring together, but for whose exertions the workers in this branch of enquiry have, none the less, good cause to be grateful. Among these names I may mention, Bell, Dr. (Ichthyolite from Kach); Blyth, E. (Siwalik Mammals); Burney, Col. (Ava Vertebrates); Burt, Lieut. (Jamna Bones); Cantor, T. (Siwalik fish-skull); Carter, Dr.; Colebrooke, Sir T. (Tibet Tertiary Mammals); Dawe, W. (Tertiary Vertebrates); Dean, E. (Jamna Mammals); Everest, Rev. R. (Siwalik Vertebrates); Felix, Major, (Narbada Mammals); Foley, Capt. (*Diodon* from Ramri Island); Frazer, Capt. (Narbada Mammals); Fulljames, Capt. (Perim Mammals); Godwin-Austen, Col. (Siwalik Mammals); Gowan, Major (*Archegosaurus* from Bijori); Hügel, Baron (Perim Fossils); Ewer, W. (Siwalik Vertebrates); Lush, Dr. (Perim Vertebrates); Ousely, Col. (Narbada Mammals); Pepper, Miss (Perim Mammals); Phayre, Sir A. (Ava Mammals); Prinsep, J. (Tertiary Mammals); Rivett-Carnac, H. (*Archegosaurus* from Bijori); Royle, (Siwalik Mammals); Sim, Lieut. (*Archegosaurus* from Bijori); Smith, Capt. E. (Jamna Mammals); Strachey, Genl. (Tibet Tertiary Mammals); Trail, Dr. (Tibet Tertiary Mammals); and Verchere, Dr. (Siwalik Mammals).

The extinct vertebrate fauna of India, with the noticeable exception of the mammalian upper Tertiary fauna, is generally remarkable for its extreme poverty; a poverty which may be due in some cases to the want of adequate research, and in others to the small number of fossils preserved in the different strata. Only here and there, in the great Gondwana series of India—which, as far as regards its higher and fossiliferous part, in serial position, in mineralogical composition, and in its fresh-water character, seems to correspond very closely with the Trias-Jura of the Connecticut valley in America,—do we find fossils locally abundant, as the reptiles of the Panchet group, and the fish and reptiles of the Kota-Maleri and neighbouring groups. With the exception of a few Cretaceous reptiles, the fossils from the above-mentioned groups, which are really very few, are the only representatives of the Pre-Tertiary land and fresh-water vertebrate fauna of which we have any traces in India.

In place of the numerous and gigantic dinosaurs of the secondary lands of Europe and America, we have in India only here and there a few bones,

indicating the former existence of a small number of species; while of the more specialized and bird-like dinosaurs of those countries, we have as yet no trace in India; neither of the toothed birds, which present so remarkable a feature in the secondary epoch of America, are there any vestiges in India. The numerous species of the volant and toothed pterodactyls of Europe, and of their toothless representatives in America, are also totally unknown from Indian strata.

Of the gigantic estuarine or marine saurians, so characteristic of the secondaries of Europe and America, Indian strata have hitherto only yielded a few remains of a single *Ichthyosaurus* and *Plesiosaurus*. Of the lower batrachians, only a few species are known from the (probably) Triassic rocks of India, and the great number of species so characteristic of the Carboniferous and Trias of Europe are almost totally unrepresented in this country. The marine fish fauna is likewise remarkable for its general poverty.*

It must, however, be observed that many of the vertebrates which do occur are only known by a single skull, or a tooth, or a few bones or scutes, and it, therefore, seems probable that many other species must have left similarly scattered remains through the strata of India, which from their extremely local distribution have hitherto escaped detection.

No distinctly recognizable traces of mammals have been as yet detected in India below the Nummulitic rocks, and in the latter only by a few generically undeterminable bones; indeed, we meet with no well-developed mammalian fauna till the period of the Upper Miocene and Lower Pliocene, when we suddenly come upon the evidence of the former existence of a vast and varied fauna which is, probably as numerically abundant in its species and genera as any known fossil fauna in the world. Previous to the Tertiary, the whole history of mammalian life in India is a complete blank. The bird-fauna of India, with a few exceptions, is almost totally unknown previously to the present epoch.

The above remarks have an important negative bearing on evolution. We know that the greater part of the peninsula of India has existed as land for an incalculable period of geological time,—at all events from the Triassic epoch, and we further know that in other regions mammals have existed on the globe since the Triassic, and birds since the Jurassic, period. As regards the above two groups of vertebrates, India throws not a single ray of light on their origin. We have not a trace of any one of the curious generalized forms of the Eocene mammals of North America in the strata of India, and yet we cannot think that ancient India was almost without mammalian life till the upper Miocene. It is indeed probable that the lost

* Marine rocks are absent over most parts of peninsular India, though present in force in Trichinopoly, Kach, Sind, and the Himalaya.

mammals of Secondary and early Tertiary India may have filled many a puzzling gap in the animal series.

It is the same with the reptiles, which were doubtless the dominant forms during the epoch of the Trias-Jura, and which have only here and there left a trace of their former existence in this country. Why may not many forms of those half-birds, half-reptiles have inhabited Secondary India of whose existence we have ample proofs in other countries; and why may not many of such Indian forms have still more closely bridged the gap which even yet exists between birds and reptiles? Great and numerous as are the advancements in uniting the scattered links of the broken chain of vertebrate evolution, it must ever be borne in mind that, while we have evidence of a large Secondary land-surface like India, which has hitherto yielded scarcely any links to this wondrous chain, we must never despair if we find that other countries are still of themselves unable to make the chain extend across all the gaps, owing to the want of a few links. Who shall say that such missing links never inhabited Secondary India, where their remains either still lie buried, or have been for ever lost beyond recovery? I, indeed, imagine that early India must have teemed with reptiles, and perhaps with higher forms of life, for it is inconceivable that this country was once mainly a mere forest of plants, of the existence of which we have such ample evidence in the Trias-Jura, unenlivened, except in one or two small spots, by vertebrate life.

I now proceed to sketch what is known of the fossil vertebrates of India, commencing with the lowest class, and tracing it through the various formations from the lowest in which it occurs to the highest; and similarly with the higher classes. I must premise that very many of the Indian fossil vertebrates are only known by extremely scanty remains, and that their affinities are consequently obscure. Of others, again, only very slight preliminary descriptions, without figures, have yet been published, and consequently foreign palæontologists have not yet had the opportunity of comparing them with other species, by which their affinities might be more fully illustrated.

FOSSIL FISHES.

Carboniferous.—The earliest fishes of which we have at present any record in India are only known by some few teeth and fin-spines, collected by Dr. Waagen and Mr. Wynne of the Geological Survey, in the Salt-Range of the Punjáb, and described by the former writer in the ‘*Palæontologia Indica.*’* These fish remains were obtained from strata termed by Dr. Waagen the “*Productus-Limestone,*” corresponding in the main to the Carboniferous. *Sigmodus dubius* is a fish belonging to a new genus founded upon a single tooth; this tooth is of an elongated conical form, and much resem-

* Ser. XIII, parts 1 and 2, 1879-80; the latter part in the press.

bles the teeth of some saurians; it is referred by Dr. Waagen to the ganoids. Another tooth, referred provisionally by Dr. Waagen to the genus *Poecilodus*, under the name of *P. paradoxus*, is of the flattened cestracient type. *Psephodus indicus* is a species formed upon the evidence of another tooth. Both these genera belong to the *Cochliodontidæ*, which Dr. Waagen classes among the Dipnoi, though they are more generally referred to the Elasmobranchii. Of the undoubted Elasmobranchii (Selachii), Dr. Waagen describes four species, belonging to three genera, from teeth, and four species, belonging to two genera, from fin-spines (ichthyodorulites). Of the teeth, two are referred to a genus (*Helodopsis*) allied to *Helodus*, under the names of *H. elongata* and *H. abbreviata*. A fragment of a tooth is referred, without specific determination, to the European genus *Psammodus*, characteristic of the Carboniferous. A fourth tooth is referred to the European genus *Petalorhynchus*, with the specific name of *P. indicus*: it is extremely doubtful whether *Petalorhynchus* is really distinct from *Petalodus* of the Carboniferous. Of the spines, or "ichthyodorulites," three specimens are referred to the American Carboniferous genus *Xystracanthus*, under the names of *X. gracilis* and *X. major* and *X. giganteus*. If I rightly understand Dr. Waagen's notes, he thinks it possible that these spines may belong to *Helodopsis*. A third spine is referred to a new genus under the name of *Thaumatocanthus blanfordi*.

As far as the evidence of these fishes goes, we find that the cestracient-toothed sharks were the dominant forms in the Indian, as well as in the European and American Carboniferous.

Trias-Jura.—In the upper part of the great Gondwána system of India, which, as I have said, probably corresponds as a whole to the Trias-Jura of other countries, remains of fishes have been found in some abundance, all of which, as far as determined, are of fresh-water types, and belong to the Ganoidei and Dipnoi, no traces of the more modern Teleostei having yet been found in these rocks. The earliest groups of rocks in the Gondwána system in which fish remains have been detected are the Mangli and Srípermatúr groups; but these remains have not yet been even generically identified. In the Kota-Maleri* group there occur nine species of Ganoids and three of Dipnoi; the former from the Kota beds have been described under the genera *Dapedius*, *Lepidotus*, and *Tetragonolepis* by Messrs. Egerton and Sykes;† many of them show Liassic affinities: the three genera

* Mr. King has lately shown a distinction between the Kota and Maleri beds; confirming the original distinction as to the Liassic affinities of the fossils of the former, and the Rhæto-triassic of those of the latter.

† Quar. Jour. Geol. Soc. of London, Vols. VII, IX, X. Palæontologia Indica, Ser. IV, part 2.

have a united range in Europe from the Lias to the Eocene: *Lepidotus* is very characteristic of the Wealden of England. Of the Maleri Dipnoi, teeth of four species of the living Queensland genus *Ceratodus* were named by the late Dr. Oldham, three of which have lately been figured by Professor Miall,* who does not admit the fourth species, *C. oblongus*.

Cretaceous.—A few fish-remains have been obtained from the Lameta rocks (of middle Cretaceous age), but are not yet determined. The next group of rocks in which fish-remains have been obtained are the upper and middle Cretaceous rocks of Trichinopoly; these remains have been described by the late Dr. Stoliczka† and Sir Philip Egerton.‡ They comprehend seventeen species of elasmobranchs, ranged under the genera *Corax*, *Enchodus*, *Lamna*, *Odontaspis*, *Otodus*, *Oxyrhina*, *Ptychodus*, and *Sphærodus*, and one ganoid doubtfully referred to *Pycnodus*. No Teleostei have been described, which is very probably owing to the less facility with which their remains are preserved; it being almost certain that they must have been represented in the Indian Cretaceous seas. The above-named genera are mainly characteristic of the Cretaceous rocks of Europe: two species are common to Europe and India. Bones, apparently of fishes, have been lately obtained by Mr. Griesbach from the Trias of Tibet. Mr. Griesbach tells me that these bones are not uncommon in the Trias limestone, but that he has not yet been able to extract any specimens in a determinable condition.

Eocene.—From the probably Nummulitic rocks of Port Blair, in the Andamans, and Rámri Island, off the Arakan coast, there have been obtained the oral teeth of a large species of *Diodon*, which I have lately provisionally called *Diodon foleyi*, after Captain Foley, the discoverer of the Rámri Island specimen.§ The living *Diodon hystrix* is now abundant off the coasts of the Andamans and Arakán, where the genus has doubtless lived since the Eocene. From Nummulitic rocks in the neighbourhood of Thyatmyo, cycloid fish-scales have been obtained,|| but are not generically determined.

From the Nummulitics of the Punjáb, some fish-scales and the dental plate of a species of ray (*Myliobatis*) have been obtained by Mr. Wynne.¶ From strata immediately overlying the Nummulitics of Kohát, Mr. Wynne has obtained the incisor of a sparoid fish belonging to the genus *Capitodus*, which has been recently described by myself as *C. indicus*;** the genus

* Palæontologia Indica, Ser. IV, part 2.

† Ibid., Cretaceous Fauna of S. India, Vol. IV.

‡ Quar. Jour. Geol. Soc. Lon. Vol. VII.

§ R. G. S. I. Vol. XIII, part I.

|| Manual of Geology of India, p. 716.

¶ R. G. S. I. Vol. X, p. 43.

** Ibid. Vol. XIII, part I.

Capitodus was previously only known from the Miocene of Vienna and Silesia, and is allied to the living genus *Sargus*.

Mio-Pliocene.—From the Siwalik rocks there were, I believe, a considerable number of fish-remains procured by Falconer and Cautley, but these were never described: the collection of fossil fish-remains from the Siwaliks in the Indian Museum is but small. Among the Teleostei, we have the siluroids represented by a very perfect skull, originally described in the Society's Journal* by Dr. Cantor as the skull of a huge frog: subsequently this skull was referred by M'Clelland† to the siluroid fishes. The latter writer describes the skull as being remarkable for its great breadth, and as carrying teeth on the jaws, but not on the palate: M'Clelland also thought that the skull might belong to a species of *Pimelodus*: this determination is, I think, certainly erroneous, because the latter genus, with one African exception, is entirely West Indian, and it is unlikely that a fresh-water genus of fishes should be found in the Pliocene of India, and now only in Africa and the West Indies. Many of the living Indian siluroids (*Clarius*, *Heterobranchus*, *Silurus*, *Silurichthys*) have palatal teeth, and the fossil cannot, therefore, belong to any of those genera. The Indian genus *Chaca*, on the other hand, is characterized, according to Dr. Günther,‡ by its exceedingly broad and depressed head, and absence of palatal teeth, and I think, therefore, it is not improbable that the fossil may belong to that genus, though, in the absence of specimens for comparison, I cannot be sure. Detached vertebræ, from the Siwaliks, also indicate the existence of teleostean and, probably, fresh water fishes, but of what group is uncertain. Of the Elasmobranchii, a few teeth indicate the former existence of a Siwalik *Lamna*, which probably inhabited the larger rivers: a single tooth from the mammaliferous beds of the Irawadi belongs to a species of *Carcharias*, and large squaline vertebræ have been obtained from Perim Island. From the Siwaliks of Sind and the Punjáb, we have some crushing palatal teeth of an undescribed fish, which I have lately sent home for determination.

Scales of teleostean fishes have been obtained by Col. Godwin-Austen from the Tertiaries or post-Tertiaries of Kashmir; they are not, however, determined.

The above notes indicate the extreme poverty of the fossil fish-fauna of India—a poverty, I think, in great part due to the want of sufficient search.

* Vol. VI, p. 583.

† Calc. Jour. Nat. Hist. Vol. IV, p. 83.

‡ Brit. Mus. Cat. of Fishes, Vol. V, p. 29.

FOSSIL BATRACHIANS.

Trias-Jura.—We now come to the history of the fossil Batrachia (Amphibia), where we shall find an equal poverty of species and genera; such as are known being merely, in all probability, a few relics left from a large fauna. The oldest Indian batrachians, like their European and American contemporaries, belong to the labyrinthodont order, characterized by the peculiarly infolded structure of their teeth. The oldest form of the order in India is only known from an undescribed skeleton obtained from a group of the Gondwána system at Bijori, hence named by Mr. Medlicott the Bijori group.* This skull was originally exhibited before our Society in 1864, and commented upon by Mr. H. F. Blanford, who thought that it should be referred either to *Archegosaurus* or *Labyrinthodon*,† adducing some evidence to shew that it belonged to the former genus. Subsequently, the specimen was alluded to as a true *Archegosaurus* by the late Dr. Oldham,‡ and still later by Mr. Medlicott.§ I cannot discover what has become of this most interesting fossil, which is certainly not in the collection of the Indian Museum, where it is only represented by a cast. Judging from this cast, I think it not improbable that the specimen really does belong to *Archegosaurus*: it much resembles a skull of that genus from the European Carboniferous figured by H. von Meyer.|| The European species being from the Carboniferous rocks does not at all preclude the Indian species from being of Triassic age, since there is considerable difference in the range in time of the Pre-Tertiary land faunas and floras of the two countries; genera having very frequently survived to a later period in India than in Europe.

From the Panchet group of the Gondwánas, we have two labyrinthodonts, to which the generic names *Pachygonia* and *Gonioglyptus* have been applied by Professor Huxley;¶ these genera are only known by fragmentary skulls and jaws; they were slender-jawed forms and allied to the labyrinthodonts of the Keuper. They are classed by Professor Miall in the group Euglypta with *Mastodonsaurus* and *Capitosaurus*. The fossils on which the two above-named Indian genera were founded are in the collection of the Indian Museum. From the nearly contemporaneous Mangli group, we have another labyrinthodont, *Brachyops laticeps* of Owen, also belonging to a genus otherwise unknown, and allied to European Jurassic, and African

* M. G. S. I. Vol. X, p. 159, (art. II, 27.)

† J. A. S. B., Vol. XXXIII, p. 337.

‡ R. G. S. I. Vol. IV, p. 70.

§ Loc. cit.

|| Palæontographica, Vol. VI, pl. XI, fig. 5.

¶ Pal. Ind. Ser. IV. part 1.

and Australian (probably) Triassic forms. The skull on which the genus is founded was described by Professor Owen.* The European Jurassic genus to which it is allied is *Rhinosaurus*, the African (Triassic?), *Micropholis*, and the Australian, *Bothriceps*; the genus seems to me to be also closely allied to *Tuditanus radiatus* of the American Carboniferous. *Brachyops* belongs to the short-jawed group of labyrinthodonts; and, with the first three above-mentioned genera, constitutes the group "Brachyopina" of Professor Miall. The skull of *Brachyops* is, I believe, in the collection of the Geological Society of London: it is represented by a plaster cast in the Indian Museum.

Tertiary.—From the Trias to the Tertiary is a long leap, but hitherto no batrachian remains have been found in India between these two formations. In the lower Tertiaries of the island of Bombay, there occur a large number of the remains of frogs belonging, apparently, to two species. The smaller of these two species was first described by Professor Owen† under the name of *Rana pusilla*; subsequently, however, Dr. Stoliczka,‡ from the absence of vomerine teeth and from the structure of the limbs, referred the species to the genus *Oxyglossus*, at the present time living in China and Siam, and, possibly, in India. A larger frog from the same beds, noticed by Professor Owen in the same paper, has not yet been generically determined. I believe that these Bombay frogs are the oldest representatives of the group.

FOSSIL REPTILES.

Trias-Jura.—The oldest members of the class Reptilia hitherto found in India belong to the orders Dinosauria and Dicynodontia (Anomodontia), and occur in the presumably Triassic rocks of Panchet near Rániganj, in the horizon known as the "Panchet group." The *Dicynodon* was originally described by Professor Huxley§ under the name of *D. orientalis*; additional remains have subsequently been described by myself,|| which show that this species belonged to the sub-genus *Ptychognathus* of Professor Owen. Other remains noticed in the latter memoir, seem to indicate the former existence of a second and larger species of *Dicynodon*. This group of reptiles seems, on the whole, to be characteristic of the Trias of India, Russia, and Africa. The dinosaur has been named *Ankistrodon indicus* by Professor Huxley,¶ and is the only known representative of the

* Q. J. G. S. L. Vol. XI, p. 37.

† Ibid. Vol. V, p. 173.

‡ M. G. S. I. Vol. VI, p. 387.

§ Pal. Ind. Ser. IV, Vol. I, part I.

|| Ibid. part 3.

¶ Loc. cit.

genus. The teeth of *Ankistrodon*, of which only two are known, have laterally compressed crowns, with serrated edges, like those of the dinosaurian *Megalosaurus* and the mammalian *Machærodus*, and are implanted in distinct sockets. The genus is allied to the Jurassic and Cretaceous *Megalosaurus*, and to various Triassic genera.

From the Denwa group of the Gondwana system, a large crocodilian scute has been obtained by Mr. Hughes,* which seems to belong to Professor Huxley's undescribed genus *Parasuchus*.

From the neighbouring Kota-Maleri group, we have the crocodilian *Parasuchus* and the lacertian *Hyperodapedon*. The genus *Parasuchus* has never been described, but only incidentally alluded to by Professor Huxley†; it was formed for the Kota-Maleri bones: it seems to have been closely allied to the Triassic *Belodon* and *Stagonolepis*. On labels attached to the bones of *Parasuchus*, now in the Indian Museum, there occurs the specific name of *hislopii*, in Professor Huxley's handwriting. *Hyperodapedon*‡ is closely allied to the living genus *Hatteria* (*Sphenodon*), represented by two species in the New Zealand Islands, and, according to Professor Huxley, to the Triassic *Rhynchosaurus*, though this is doubted by Professor Owen.

From the undoubtedly Jurassic rocks of Kach (Cachh), there has been obtained (Chári group) a vertebra which I think very probably belongs to *Parasuchus*, though I cannot be certain;§ and (Umia group) a fragment of a lower jaw of a *Plesiosaurus*, which I have named *P. indicus*:|| the specific affinities of the latter cannot be fully determined from the fragment.

Cretaceous.—From the Cretaceous rocks of India, we have, among the Dinosauria, a species of *Megalosaurus*, certainly from the Trichinopoli, and probably from the Lameta rocks (middle Cretaceous);¶ this genus is only known in India by detached teeth; in Europe, it ranges from the Jurassic to the lower Cretaceous (Wealden). From the Lameta rocks, there have also been obtained the remains of another gigantic genus of dinosaur, allied to the Wealden *Pelorosaurus* and the Jurassic *Cetiosaurus*, which I have named, from the great size of the bones, *Titanosaurus*;** from the evidence of the vertebræ, there appear to have been two species, *T. indicus* and *T.*

* Pal. Ind. Ser. IV. part 3.

+ Q. J. G. S. L. Vol. XXVI, p. 49, XXXI, p. 427.

‡ Ibid. XXV, p. 151.

§ R. G. S. I. Vol. X, p. 35.

|| Pal. Ind. Ser. IV, part 3.

¶ Ibid.

** Ibid.

blanfordi. *Titanosaurus* was a gigantic and, probably, land reptile, but whether bipedal or quadrupedal is not known. Remains of another, but much smaller, reptile have been also obtained by Mr. Hughes from the Lameta rocks; the remains are, however, not sufficient for generic determination, but I think it not impossible that they may have belonged to a dinosaur.

Of the Cretaceous Crocodylia, we only know of one species by some amphicoelian vertebra and scutes obtained by Mr. W. T. Blandford from the upper Cretaceous rocks of Sind.* As far as I can judge, from these imperfect remains, they appear to indicate an animal allied to *Suchosaurus* of the Wealden of England.

The Chelonia are only known to have existed in India during the Cretaceous period by the evidence of some broken plates, in the collection of the Indian Museum, obtained from the Lameta group, from the intra-Trappeans of Rajamahendri (Rajamundry), and from the upper Cretaceous rocks of Sind. These remains are in far too imperfect condition for even generic determination.

A large species of *Ichthyosaurus*, which I have called *I. indicus*,† is known solely by a few vertebræ collected by Mr. Foote in the middle Cretaceous rocks of Trichinopoly. *Ichthyosaurus*, in England, ranges from the Lias to the Chalk.

Eocene.—The only specifically known Eocene Indian reptile with which I am acquainted, has been referred by the late Dr. Gray‡ to the genus *Hydraspis* belonging to the family Emydidæ. The specimen on which the determination rests is a carapace, from the intra-Trappean rocks of Bombay, originally named by Mr. Carter *Testudo leithii*. The genus *Hydraspis* is now found living exclusively in Tropical America. From the Nummulitics of the Punjáb, remains of Crocodylia have been obtained by Messrs. Theobald and Wynne, of the Geological Survey, but are not generically determined.

Mio-Pliocene and Pleistocene.—From the Mio-Pliocene Siwaliks and from the Pleistocene Narbadas, a considerable number of reptilian remains have been obtained, but, in many cases, have not yet been described. Remains of Crocodylia have been obtained in considerable numbers from the Sub-Himalayan Siwaliks and from the corresponding rocks of Burma, Perim Island, and Sind; and many of them have been named by Falconer. Of the genus *Crocodylus*, a Siwalik species has been identified with the living *C. palustris* (*bombifrons*, Gray).§ Remains of a crocodylian have

* Pal. Ind. Ser. IV. part 3.

† Ibid.

‡ Ann. Mag. Nat. Hist. Ser. IV, Vol. VIII, p. 339.

§ Cat. Foss. Vert. A. S. B. p. 200. The cranium there named *C. palaindicus* seems to belong to *C. palustris*.

also been obtained from the Irawadi and the Narbada, but their specific determination is difficult. Of the genus *Gharialis* (*Leptorhynchus*), one Siwalik species has been identified with the living *G. gangeticus*; a gharial from the Manchhars of Sind also belongs to this species. Another long-jawed Siwalik crocodile with slender teeth has been named *Gharialis leptodus*; and another with much shorter jaws and teeth, *G. crassidens*; the latter has been obtained from the Siwaliks and from Sind.

Of the order Lacertilia, only one Siwalik representative is known, belonging to the genus *Varanus*, and named by Falconer *V. sivalensis*.* This determination was made on the evidence of a distal extremity of the humerus, now in the British Museum.

The Ophidia are only known by some vertebræ, much like those of the genus *Python*, obtained from the Siwaliks of the Punjáb and Sind: these vertebræ have not yet been generically determined.

The Chelonia are known by a considerable number of Siwalik, and two Narbada, species. Of the land tortoises, we have, firstly, the gigantic extinct species, *Colossochelys atlas* of Falconer and Cautley, from the Siwaliks and the Irawadi. Falconer says that the fossil species is mainly distinguished from the living genus *Testudo* by the thickening of the anterior (episternal) portion of the plastron; this character was considered to be only of subgeneric value, and I think the species might well be named *Testudo atlas*. The length of the carapace, according to Falconer's restoration, is 12 feet 3 inches, and of the entire animal with the head and tail extended, 22 feet. In addition to *Colossochelys*, there is good evidence of the former existence of other gigantic tortoises in the Siwalik period. In the Indian Museum, there are several specimens of the ankylosed episternals of tortoises belonging to two distinct species. These bones are as thick, but not so elongated, as the episternals of *Colossochelys*; they have diverging but shorter extremities than in the latter genus. The animals to which these bones belonged must have been, I think, two-thirds as large as *Colossochelys*, and may not improbably have belonged to *Testudo*. A broken episternal indicates a third, but smaller species. A fourth species is indicated by three episternals, which are not bifurcated at their free extremities: these bones indicate a smaller animal. The episternal bones, from their solidity, seem more frequently preserved than any others. A single carapace of a small tortoise in the Indian Museum, from the Siwaliks, seems to belong to the genus *Testudo*. Among the hard-shelled emydine tortoises, we have, from the Siwaliks, a species of *Bellia* described by Mr.

* Pal. Mem. Vol. I, pl. XXXII, figs. 4-7.

Theobald* under the name of *B. sivalensis*. This species, according to Mr. Theobald, is very closely allied to *B. crassicollis*, which, according to the same writer,† inhabits Tenasserim, Siam, and Sumátra. The other living species (*B. nuchalis*) inhabits Jáva. Another carapace of a Siwalik emydine, in the Indian Museum, seems to belong to a second species of *Bellia*. In labels on the casts of Siwalik fossils from the British Museum, a three-ridged carapace of an emydine bears the name of *Emys hamiltonoides* (Falc. and Caut.): this name was doubtless given from the resemblance of this carapace to that of the living *Damonia* (*Emys*) *hamiltonii*, now inhabiting Lower Bengál: the generic name of the fossil should probably be *Damonia*. An imperfect carapace, collected by Mr. Theobald in the Siwaliks of the Punjáb, and now in the collection of the Indian Museum, seems to belong to *Emys* proper. Mr. Theobald has lately described,‡ under the name of *Cautleya annuliger*, a gigantic Siwalik emydine, from the evidence of a single marginal bone; the genus is said to be distinguished from all other emydines by the cartilaginous, in place of osseous, union of the marginal with the adjoining bones. In the family *Bataguridæ*, Dr. Falconer determined the identity of a Siwalik emydine with *Pangshura* (*Emys*) *tectum* of Bell§; subsequently, the species was shown by Dr. Stoliczka|| to occur in the newer Narbada deposits also: *Pangshura tectum* now inhabits Lower Bengál. Of the genus *Batagur*, a part of a plastron from the Narbada has been thought by Dr. Stoliczka¶ to belong very probably to *B. dhongoka*, now found living in the Narbada. Remains of a large *Batagur*, from the Siwaliks, are contained in the collection of the Indian Museum, but have not yet been specifically determined. A small carapace, with a ridge on the vertebral plates, lately presented by the Rúrki Museum to the Indian Museum, very probably belongs also to *Batagur*. Of the soft-shelled river-tortoises, a *Trionyx* from the Narbada has been thought by Dr. Stoliczka** to be not improbably identical with the living *T. gangeticus*. Plates of an undetermined *Trionyx* have been obtained in considerable numbers from the Sub-Himalayan Siwaliks, and from those of Burma and Perim Island. A carapace of an *Emyda* in the British Museum, from the Siwaliks, has been identified by Dr. Gray with the living *Emyda vittata* (*ceylonensis*, Gray). This species, according to Mr. Theobald, inha-

* R. G. S. I. Vol. X, p. 43.

† Catalogue of Reptiles of India, p. 10.

‡ R. G. S. I. Vol. XII, p. 186.

§ Pal. Mem. Vol. I, p. 382.

|| R. G. S. I. Vol II, p. 39.

¶ Loc. cit.

** Loc. cit.

bits Central and Southern India and Ceylon. In the Indian Museum there are numerous remains of *Emyda* from the Siwaliks of the Punjáb, Burma, and Perim Island, which may or may not belong to the last-named species.

General Remarks.—The foregoing notes will show that the fossil reptiles of India are noticeable for the extreme paucity of species known, and for the fragmentary remains of the known species. The Mesozoic Reptilia belong, as far as described, to extinct genera: the one known Eocene reptile (*Hydraspis*) belongs to a living genus, but one which is now far removed from India. The Siwalik (Mio-Pliocene) reptiles appear in great part to belong to living Indian genera, and in many cases to living species; the modern representatives are, however, in most cases, found no longer in the Sub-Himalayan districts, but are now confined to Southern India. The Narbada fossil reptiles, in all probability, belong altogether to living species, and probably to species inhabiting the same district.

FOSSIL BIRDS.

Mio-Pliocene.—Fossil remains of birds have hitherto been found in India only in the Sub-Himalayan Siwaliks, and there only in comparatively small numbers. Some of their remains are in the Indian Museum, and have been partly described by myself,* while others are in the British Museum, and have been lately described by Mr. Davies.† Among the carinate birds, a tarso-metatarsus is considered by Mr. Davies to belong to a cormorant, possibly of the genus *Graculus*.‡ A species of pelican (*Pelecanus cautleyi*) is indicated by a fragment of an ulna; this bird, according to Mr. Davies, must have been somewhat smaller than the living Indian *P. mitratus*. Another part of an ulna has been referred to a new species (*Pelecanus sivalensis*) by Mr. Davies, with a reservation as to the generic determination. A gigantic wader has been described by myself, under the name of *Megaloscelornis sivalensis*, from the evidence of a sternum and tibiotarsus. A distal extremity of a large bird humerus in the Indian Museum, collected by Mr. Fedden in Sind, has a diameter of 2 inches across the condyles: I cannot at present identify this bone with the humerus of any living genus of bird: from its size it might belong to *Megaloscelornis*; it makes some approach to the humerus of *Ploteus*. A species of adjutant has been named by Milne-Edwards *Argala falconeri*.§

* R. G. S. I. Vol. XII, p. 52.

† Geol. Mag. January 1880, p. 18.

‡ This bone was doubtfully referred by M. Edwards to *Phaëton*.

§ The bone in the British Museum referred to by myself on page 56 of the above quoted paper belongs to this species.

There are also two small undetermined bird bones in the Indian Museum. The Struthioid or Ratitian modification of bird structure appears to have been represented by three Siwalik species; *viz.*, an ostrich (*Struthio asiaticus*) indicated by some of the bones of the lower leg and foot and by vertebra: an emeu (*Dromæus sivalensis*), by bones of the foot: and, according to Mr. Davies, a three-toed bird, intermediate between these two genera, by a single phalangeal bone. The living ostrich is confined to the African continent, and the emeu to New-Holland; the occurrence of fossil species of these genera in the higher Tertiaries of India, probably points to a late land connection between these countries.

FOSSIL MAMMALS.

Eocene.—No traces of mammals have hitherto been detected in India below the Eocene, and in the latter formation only some fragmentary bones have been obtained by Mr. Wynne in the Nummulitics of the Punjáb. The only determinable bones consist of the distal portion of the femur and metatarsals of a probably perissodactyle animal, and the astragalus of an artiodactyle.* The femur was obtained from the Nummulitic (Subáthú) zone of the Punjáb, while the astragalus was obtained immediately above the Nummulitic clays of Fatehjang in the Punjáb, which are probably of upper Eocene age. The astragalus seems certainly to be that of a ruminant, as it belonged to an animal in which the navicular and cuboid bones were united. If this determination be correct, ruminants existed in the upper Eocene period.

Mio-Pliocene.—The Tertiary ossiferous rocks of Perim Island, Sind, the Punjab, the Sub-Himalayan Siwaliks, Sylhet, Tibet, and the valley of the Irawadi, have yielded a large number of mammalian and other vertebrate fossils, many of which are represented in the collection of the Society, now transferred to the Indian Museum. The fossils of the Irawadi valley were first brought to notice by Crawford and Clift, while those of the typical Siwaliks were rendered classic by the labours of Falconer and Cautley, and other former members of this Society. Some of these fossiliferous beds are of Miocene, and others of Pliocene age, and an admirable *resumé* of their distribution and relations are given in the 'Manual of the Geology of India,' to which work I must refer my readers desirous of further information on this subject.

The Siwalik Primates are at present known merely by a few fragments of upper and lower jaws and teeth, and it is probable that more species remain to be discovered. The known forms comprehend a large anthropoid ape, which has been named *Palæopithecus sivalensis*;† this

* R. G. S. I. Vol. IX, p. 92. In that passage the words "*mammaliferous* clays," should be "*nummuliferous* clays."

† R. G. S. I. Vol. XII, p. 38.

species is known by the palate of a female and the canine of a male, and seems to have been allied to the living orang of Borneo, but is distinguished by the form of its premolars; two species of (probably) *Semnopithecus* and two of *Macacus** have also been determined.

Among the Carnivora, we have a large tiger (*Felis cristata*)† characterized by its large sagittal crest; a second species has lately been described by Mr. P. N. Bose under the name of *F. grandicristata*,‡ with a still larger crest; while a third and much smaller species is indicated by a lower jaw in the Indian Museum. Of the genus *Machairodus* (*Machærodus*), there is *M. sivalensis* of Falconer and Cautley, said by Mr Bose to be equal in size to the jaguar, and a larger species described by the same writer under the name of *M. palæindicus*. The genus *Pseudælorus*, distinguished from *Felis* by the presence of an additional lower premolar, is known by one lower jaw, which I have referred to a new species under the name of *P. sivalensis*.§ Among the civet-like animals, we have *Viverra bakeri* of Mr. Bose, said to be closely allied to the living civet, and *Ictitherium sivalense* described by myself from a lower jaw.|| The hyænas are represented by *Hyæna sivalensis* of Falconer and Cautley, said by Mr. Bose to present relationship both to the Indian *H. striata* and the African *H. crocuta*; and *H. felina* of Mr. Bose, distinguished by the absence of the first upper premolar. The dogs, according to the same writer, are represented by two species of *Canis* (*C. curvipalatus* and *C. cautleyi*), the latter closely allied to the wolf; there is a specimen of the palate of a *Canis* in the Indian Museum, but I am at present unable to say whether it belongs to either of the above species. The genus *Amphicyon*, distinguished from *Canis* by the presence of an additional upper molar, is represented by *A. palæindicus*,¶ remains of which have been obtained from Sind and the Punjáb. The bears are known by a single undescribed cranium of *Ursus* in the Indian Museum, and by the remarkable genus *Hyænarctos*, of which two species are known: *H. sivalensis*** was the original species on which the genus was founded, and has the upper molars with quadrangular crowns; a tooth apparently belonging to this species has been described by Professor Flower from the newer Pliocene (Red Crag) of

* R. G. S. I. Vol. XII. p. 92.

† Pal. Mem. Vol. I, p. 315. In manuscript the name of *Felis palæotigris* occurs.

‡ Of this and five other species of Siwalik Carnivora, described by the same writer, I have only seen the notice given in 'Nature,' Jan. 1st, 1880.

§ R. G. S. I. Vol. X, p. 83.

|| Ibid. p. 32.

¶ Pal. Ind. Ser. X, Vol. I, p. 84. *Megalotis* (*Otocyon*) normally agrees with *Amphicyon* in having three upper true molars: it may, however, according to Prof. Flower, have four of these teeth.

** F. A. S. pl. O.

England: the second species, named by myself *H. palæindicus*,* is known only by an upper jaw, not yet figured; the upper molars of this species have triangularly shaped crowns, somewhat like those of *Amphicyon*. Of the subursoid Carnivora, we have the living Indian and African genus *Mellivora*, represented by *M. sivalensis*,† apparently very closely allied to the living Indian species. A species of badger (*Meles*) is indicated by one lower jaw collected by Mr. Theobald.‡ Of the otters, one species of *Lutra* (*L. palæindica*) has been named by Falconer and Cautley from a skull and lower jaw§; another lower jaw in the Indian Museum, collected by Mr. Theobald, not improbably belongs to a second Siwalik species. *Enhydriodon*|| is a genus peculiar to the Siwaliks, and is allied to the living sea-otter (*Enhydris*) now inhabiting the shores of the North Pacific; the Siwalik genus was not improbably a river-dwelling form.

Of the Proboscidea, now represented only by the Indian and African elephants, there were a large number of Siwalik species, belonging to the genera *Elephas*, *Mastodon*, and *Dinotherium*. Of the first-named genus, there were three sub-genera living in Siwalik times, viz., *Euelephas*, *Loxodon*, and *Stegodon*. *Euelephas* was represented by *E. hysudricus*, provided with simpler molars than the living representative of the sub-genus; *Loxodon* was represented by *L. planifrons*, remarkable for being the only species of elephant in which premolars are known to have been developed. The sub-genus *Stegodon* is peculiar to South-Eastern Asia, and was represented by four species in the Sub-Himalayan and other Indian Siwaliks: these species are named *S. ganesa*, *S. insignis*, *S. bombifrons*, and *S. cliftii*. The molars of the two first are more complex than those of either of the other two, and are indistinguishable from each other; the skull of the first species is distinguished by its enormously developed tusks. The intermediate molars of *S. cliftii* have not more than six ridges each. From (probably) Pliocene deposits in China, two stegodons have been described by Professor Owen under the names of *S. sinensis* and *S. orientalis*, which appear to be respectively the same as *S. cliftii* and *S. insignis*.¶ Of the mastodons, five species, *M. sivalensis*, *M. latidens*, *M. perimensis*, *M. pandionis*, and *M. falconeri*, have been described from the Mio-Pliocene of India: the three first-named species belong to the tetralophodont, and the two last to the trilophodont, sub-division of the genus: the two first-named species have a tendency to a pentalophodont molar formula. Of the European

* R. G. S. I. Vol. XI, p. 103.

† Ibid. p. 102: named in 'F. A. S.' *Ursitaxus*.

‡ R. G. S. I. Vol. XI, p. 102.

§ F. A. S. suppl. pl. Pl.

|| Ibid.

¶ Pal. Ind. Ser. X, Vol. I. pt. 5 (in the press.)

Miocene genus *Dinotherium*, three species, *D. indicum*, *D. pentapotamiæ*, and *D. sindiense*, have been described from the Indian Mio-Pliocene: the last species presents a remarkable approximation to the mastodons in the form of its mandible.*

The perissodactyle modification of the great order Ungulata is well represented, both in genera and species, in the Indian Mio-Pliocene. Of *Rhinoceros* there are four named species, *R. iravadicus*, *R. sivalensis*, *R. palæindicus*, and *R. platyrhinus*;† the molars of the two first are constructed on the type of those of *R. sumatrensis*; those of the last on the type of those of *R. indicus*; *R. sivalensis* and *R. palæindicus* were unicorn, and *R. platyrhinus* was bicorn. Bones of one species have also been obtained from Tibet. The hornless rhinoceroses were represented by *Acerotherium perimense*, of which there is a fine undescribed skull from the Punjab in the Indian Museum.‡ It is doubtful if the genus *Tapirus* is represented in the fossil state in India; a symphysis of a mandible has been figured in the second volume of the second series of the 'Transactions of the Geological Society of London' by the late Mr. Clift, and referred to *Tapirus*, but I think the determination is at least open to doubt. Molars of *Listriodon* were described in MSS. by Falconer under the name of *Tapirus* and so published in the 'Palæontological Memoirs.'§ The genus *Listriodon*|| is represented by two species, *L. pentapotamiæ* and *L. theobaldi*. The genus *Chalicotherium* is represented by one species (*C. sivalense*),¶ presenting some peculiar points in its dentition: this genus has till lately been classed with *Anoplotherium* among the Artiodactyla, but Professor Cope has lately come to the conclusion that it is a perissodactyle allied to *Palæotherium*. The horses are represented by the genera *Equus* and *Hippotherium* (*Hipparion*). *Equus* is known by a Siwalik species (*E. sivalensis*),** never fully described, and by one from the Tibetan

* For figures and descriptions of the Indian fossil Proboscidea, see F. A. S. and Pal. Ind. Ser. X, Vol. I, pt. 5 (in the press): a jaw of *D. pentapotamiæ* was described as *Antoletherium* by Falconer.

† F. A. S. and Pal. Ind. Ser. X, Vol. I.

‡ Some molars of this species were described by myself under the name of *Rhinoceros planidens*. *R. Sivalensis* has lately been made the type of a new genus *Zalabis* by Prof. Cope, but on insufficient grounds.

§ Vol. I, p. 415.

|| Pal. Ind. Ser. X, Vol. I. and R. G. S. I. Vol. XI, p. 98 I have followed Professor Cope in classing this genus with the tapirs; Kowalewsky was inclined to place it among the artiodactyles.

¶ Pal. Mem. Vol. I, pl. XVII.

** Professor Huxley (Q. J. G. S. L. 1870, Presid. Address) remarks that some of the Siwalik horses show traces of a "larmial" cavity on the skull. I do not know whether this remark applies to the Siwalik or Narbada horse, but probably the former as the older.

Tertiaries : of *Hippotherium*, there are two Siwalik species, *H. antilopinum* and *H. theobaldi** : remains of the genus have also been obtained from Tibet. M. Gaudry remarks† that the Siwalik *Hippotheria* have no lateral digits ; this may possibly be the case with *H. antilopinum*, but it is certainly not so with the larger *H. theobaldi*, of which there is a nearly complete tridactyle foot in the Indian Museum. *H. theobaldi* has not yet been fully described ; it is very like *H. gracile*, to which species some Siwalik molars were referred by H. von Meyer‡ under the name of *Equus primigenius*.

Of the artiodactyle modification of the Ungulata, there is a still longer list in the Indian Mio-Pliocene. In the bunodont sub-division, we have *Hippopotamus* represented by two species (*H. iravadicus* and *H. sivalensis*), both belonging to the hexaprotodont sub-genus. A Siwalik bunodont (*Tetraconodon magnum*)§ is noticeable for its enormous conical premolars ; this genus is probably related to *Entelodon* (*Elotherium*) of the Tertiaries of Europe and America. The true pigs (*Sus*) are represented by three species, *S. giganteus*, *S. hysudricus*, and *S. punjabiensis* ; the two former were named by Falconer and Cautley, while the last name was applied by myself.|| *Sanitherium* is a small suine animal, only known by the lower molars. *Hippohyus* is a genus of suine animals whose molars present a peculiar complexity of pattern, recalling that of the molars of the horse ; the genus is peculiar to the Siwaliks, where it appears to have been represented by two species.¶ The European Miocene genus *Hyotherium* is represented in the Tertiaries of Sind and Perim Island by a species which I have provisionally named *H. sindiense*** Of the suine animals with selodont teeth, we have, among the forms with five cusps on the molars, a species of *Anthracotherium* (*A. silistrense*)†† from Sind, the Punjáb, and Sylhet, and a species of *Hyopotamus* (*H. sindiense*)‡‡ from Sind : among the forms characterized by having only four cusps on the molars, we have four genera, *Merycopotamus*, *Charomeryx*, *Hemimeryx*, and *Sivameryx*,§§ all peculiar to the Sind and Punjáb Siwaliks, and each known only by a single species :||| the two last genera are at present undescribed.

* Milk-molars of this species were at first referred to a new genus, *Sivalhippus*, by myself (R. G. S. I. vol. X. pp. 31. 82).

† " Animaux Fossiles and Geologie de l'Attique" p. 231.

‡ Palæontographica, Vol. XV, p. 17.

§ Pal. Ind. Ser. X, Vol. I.

|| R. G. S. I. Vol. XI, p. 81. A suine animal has been named by myself *Hippopotamodon*, but I am now not certain of its generic distinctness.

¶ Ibid. p. 82. ** Ibid p. 77.

†† Ibid. p. 78, a jaw of this species was described by me as *A. punjabiense*.

‡‡ Ibid. Vol. X, p. 77. §§ Ibid. Vol. XI, pp. 78, 80.

||| Falconer in a MS. note described some teeth of *Dorcatherium*, under the name of *Merycopotamus nanus*. (Pal. Ind. Ser. X, Vol. I.)

Among the true ruminants, we have the deer family represented by several species of *Cervus*, namely, *C. triplidens*, *C. simplicidens*, and *C. latidens*; the genus of the last being somewhat doubtful. A fourth undescribed species has been named *C. sivalensis*.* The genus *Dorcatherium* is represented by the two species, *D. majus* and *D. minus*.† At least one of the Siwalik deer had branching antlers with a flattened beam, somewhat like those of the living *C. duvaucellii*. *Cervus triplidens* had a large accessory column in the molars, while *C. simplicidens* was a species as large as the Káshmir stag, with a much smaller accessory molar column. A single molar in the Indian Museum seems to indicate a Siwalik representative of the genus *Palæomeryx*. The giraffes were represented in India by probably two species, one of which has been named *Camelopardalis sivalensis*.‡ Of the family Sivatheriidæ, which, with the exception of *Helladotherium*§ from the Pikermi beds of Attica, is peculiar to India, we have four genera in the Mio-Pliocene. *Hydaspitherium* is represented by probably three species, *H. megacephalum* known by the skull, which carried a massive conjoint horn-base above the occiput; and *H. leptognathus* and *H. grande*, by lower jaws and teeth. *Bramatherium perimense* is known by the skull, teeth, and jaws; this species seems to have carried a pair of horns over the occiput and a large conjoint horn-base on the frontals. *Vishnutherium iravadicum* is at present only known definitely by a fragment of a lower jaw from Burma of much smaller size than any of the other genera: it is not impossible, however, that some nondescript upper molars, in the Indian Museum, from the Punjáb, may belong to this genus. *Sivatherium giganteum* was the first known of this group of animals, and was originally described in the Society's Journal|| as a fossil elk: several skulls of this species are known; the male carried two pairs of horns, placed like those of the living Indian four-horned antelope (*Tetraceros*), while the female was hornless. An elaborate memoir on this interesting animal has been published by Dr. Murie.¶ The molar teeth seem to be nearest to those of the giraffes, and also approach those of *Cervus megaceros* and *Alces*: Dr. Murie comes to the conclusion that the horns of *Sivatherium* were intermediate in structure between the antlers of deer and the horns of the true cavicorn ruminants, and that they probably

* Pal. Ind. Ser. X, Vol. I, Preface (in the press).

† Ibid.

‡ Remains of this species were described under the names of *C. sivalensis* and *C. affinis* by Falconer. See R. G. S. I. Vol. XI, p. 83.

§ Pal. Ind. Ser. X, Vol. I, R. G. S. I. Vol. XI, p. 90. M. Gaudry in his work, 'Les Enchainements du Monde Animal,' mentions that *Helladotherium* occurs in India: I am unacquainted on what grounds.

|| Vol. IV, p. 506.

¶ Geol. Mag. Vol. VIII, p. 438.

carried a deciduous sheath like those of the living American prong-buck (*Antilocapra*). Of the antelopes, several species have been described, the largest of which (*A. palæindica*)* is supposed to have presented affinities to some African forms; *A. sivalensis*† is allied to the Indian blackbuck (*A. cervicapra*); while *A. patulicornis* and *A. acuticornis* do not appear to come close to any living forms. Other molar teeth belong to a species of *Portax*, now only represented by the living nilghai of India. Others again are like those of *Palæoryx*, a genus of antelopoid animals described from the Pikermi beds of Attica; this determination, owing to the absence of skulls and the great difficulty of precisely determining isolated ruminant teeth, is only provisional. The oxen are represented by five genera, among which *Hemibos* is represented by three species, *H. occipitalis*, *H. acuticornis*, and *H. antilopinus*:‡ this genus is peculiar to the Siwaliks, and connects the oxen and antelopes. *Leptobos falconeri* is another species of antelopoid oxen, known by some crania. The genus *Bubalus* is represented by *Bubalus platyceros*, a species with horns concave superiorly; and, in the highest Siwalik, by *B. palæindicus*, which is extremely close to the living wild buffalo of Assam. Of the genus *Bison*, there is only one species in the Siwaliks, which has been named *B. sivalensis*, and which seems to have been related to the extinct European *B. priscus*. Of the true oxen (*Bos*) there are three Siwalik species, namely, *Bos acutifrons* remarkable for its enormous horns and angulated forehead; *B. planifrons* with shorter horns and a flattened forehead, and allied to the gigantic *Bos primigenius* of Europe; and *Bos platyrhinus* only known by the lower half of a skull, and of which the generic affinities are doubtful. There seem to have been four species of goats in the Indian Tertiaries, most of which are probably of Pliocene age, viz., an unnamed species with horn-cores very like those of the Himalayan *Capra falconeri* (markhor), and two named species, *C. sivalensis* and *C. perimensis*, both of which are only known by frontlets and horn-cores: the fourth species has been described by Professor Rüttimeyer under the name of *Bucapra daviesii*. No remains of the genus *Ovis* have hitherto been described from the Sub-Himalayan or other Indian Siwaliks, but a cranium obtained from the presumably Siwalik strata of Tibet has been referred by the late Mr. Blyth to this genus. The genus *Camelus* is known by *C. sivalensis*, which presents a pe-

* Pal. Mem. Vol. I, pl. 23.

† Pal. Ind. Ser. X, Vol. I. Two species (*A. picta* and *A. gyricornis*.) were named in MSS. by Falconer.

‡ These three species have been also described under the generic names of *Probalus*, *Amphibos*, and *Peribos*; the synonymy will be found in the first volume of the tenth series of the 'Palæontologia Indica,' where all the other Indian fossil ruminants are noticed. Part of this volume is still in the press.

culiarly in the lower molars, connecting it with the American auchenias, and distinguishing it from the other old-world camels.* The similarity of the lower molars of the Siwalik camel and *Auchenia* is very noteworthy, since America is supposed to have been the original home of the *Camelidæ*: this supposition is supported by the connection between the living American camels (*Auchenia*) and the Pliocene old-world camels.

The other orders of Mammalia are only represented by a few species of Rodentia and one of Edentata. Among the rodents, a rat (*Mus*) is mentioned by Falconer as a member of the Siwalik fauna. A species of bamboo-rat (*Rhizomys sivalensis*)† has been named by myself, from some lower jaws collected by Mr. Theobald in the Punjáb. A porcupine (*Hystrix sivalensis*) is known by a part of a cranium and a lower jaw.

The edentates are only known by one species of pangolin (*Manis sindiensis*), which has been named on the evidence of a solitary phalangeal bone from Sind.‡

The Mio-Pliocene mammalian fauna of India, as a whole, is characterized by the great number of forms belonging to the orders including animals of large corporeal bulk, and also by the admixture of modern African and Miocene European genera with those now peculiar to India. The Proboscidea and the perissodactyle Ungulata, now so sparingly represented on the globe, were abundant in Mio-Pliocene India, and were probably the dominant forms: the ruminants have now diminished somewhat in numbers in several groups, but not to such a striking extent as the proboscideans. The selenodont hogs, like *Merycopotamus* and *Anthracotherium*, belong to a group which has completely passed away, while their congener the hippopotamus is now confined to Africa. Of the larger mammals now inhabiting India, nearly all are generically represented in the Pliocene, while forms, like *Anoa* (the living representative of *Hemibos*), inhabiting neighbouring countries seem to have descended from Indian ancestors. The micro-mammalia are practically unrepresented in the Mio-Pliocene, but this is probably due to the smaller chance of their remains being preserved in a fossilized condition, or, if so preserved, of being discovered.

PLEISTOCENE.

The mammals of the Pleistocene of India are as yet even less well known than those of the Mio-Pliocene, owing to the smaller areas in which

* A second species of Siwalik camel was named in MSS. *C. antiquus* by Falconer. This species cannot now be identified.

† For descriptions of this and other Siwalik rodents, see R. G. S. I. Vol. XI, p. 100. *Rhizomys* is probably the same as *Typhlodon* of Falconer.

‡ Pal. Ind. Ser. X, Vol. I.

they are found. It seems, however, even with our present knowledge, to be pretty safe to say that the numerical strength of species of the larger mammals so characteristic of the Mio-Pliocene had disappeared in the Pleistocene. From the older alluvium of the Jamna river, mammalian bones have been obtained in considerable quantities, but only two species have been satisfactorily determined; the remaining bones have only been generically named, and are, therefore, not referred to here, as it is in many cases impossible to say whether they belong to living or to extinct species. The presence of *Hippopotamus* remains in a stratum is pretty good evidence of such stratum being not newer than the Pleistocene. The discovery of a molar and canine of this genus in the alluvia of the Pempanga river, by Mr. Fedden, consequently shows that some of those deposits should be referred to the Pleistocene. In many cases, as in the delta of the Ganges, it is often most difficult, or impossible, to draw the line between the Pleistocene deposits and the Recent alluvium of the same area.

In the laterite of Madras, stone implements, and a human tibia have been found by Mr. Foote, and are assigned to the Pleistocene by Professor Boyd-Dawkins. Stone implements have likewise been obtained from the ossiferous beds of the Narbada valley, in association with the remains of extinct mammals. The mammalian fauna of the Narbada beds comprises, among the Carnivora, a species of bear (*Ursus namadicus*), named by the authors of the 'Fauna Antiqua Sivalensis' on the evidence of a portion of the maxilla with the molar dentition: this specimen is now in the British Museum, presented by Captain Frazer.* Among the Proboscidea, we have the extinct *Euelephas namadicus*, characterized by the extraordinary ridge on the forehead; the molars of this species are very like those of the European *Elephas antiquus*, from which Professor Leith Adams has thought that the Indian and European forms might belong to the same species. *Stegodon* was represented by *S. ganesa* and, possibly, by *S. insignis*. Among the fossil perissodactyles of the Pleistocene, we have *Rhinoceros deccanensis*† of Mr. Foote from the Deccan, a species without permanent lower incisors, and shewing African affinities; and from the Narbada the living *R. indicus*, remains of which were at first named *R. namadicus*. A third species (*R. namadicus*) probably also existed in the Pleistocene. The horses are represented by *Equus namadicus*,‡ as yet not fully described. Among

* F. A. S. plate O. I have elsewhere mentioned a species of *Felis* from the Narbada beds, the determination having been made on the evidence of the olecranal portion of an ulna in the old collection of the Geological Survey; the history of the specimen is, however, unknown, and from its mineral condition I am by no means sure that it is from the Narbada.

† Pal. Ind. Ser. X, Vol. I.

‡ Faun. Ant. Siv. *E. palæonus* seems to be the young of *E. namadicus*.

the artiodactyles, we find two species of *Hippopotamus*, one of which (*H. namadicus*) belongs to the hexaprotodont type, while the other (*H. palæindicus*) is tetraprotodont, like the larger living species;* *H. palæindicus* has also been found in the older alluvia of the Jamna. The pigs seem to have been represented by *Sus giganteus*.† A species of stag was named by Falconer *Cervus namadicus*, but never described; a single molar from the Narbada in the Indian Museum is indistinguishable from the corresponding tooth of the living *C. (Rucervus) duvaucellii*. Three species of Narbada oxen have been described, viz., *Bos namadicus* of Falconer and Cautley, a taurine ox showing some affinities to the living Asiatic genus *Bibos*, also occurring in the Pem-ganga alluvium and, possibly, in the Deccan; *Bubalus palæindicus* of the same authors, very closely allied to the living wild Indian buffalo, also found in the Jamna alluvium; and *Leptobos frazeri* of Professor Rüttimeyer. A species of nilghai (*Portax*) has lately been described by the same writer from the Narbada rocks, under the name of *P. namadicus*; teeth of the same genus have also been obtained from the Pem-ganga alluvium.

The Pleistocene rodents are only represented by some incisors probably belonging to the genus *Mus*, obtained from the Narbada valley, and now in the Indian Museum.

RECENT.

The Recent deposits have not yet, as I have said, in many cases been satisfactorily separated from the Pleistocene, and the very local occurrence of mammalian bones renders this point of doubt one not likely to be soon cleared up. Any alluvial deposits of bones from which *Hippopotamus* is absent, and which do not contain any other extinct animals, I should be disposed to class as Recent.

Human remains have been obtained in the alluvium of the plains in various localities, at considerable distances below the surface, but generally in very imperfect condition. Specimens of the teeth and jaws of *Macacus rhesus* are exhibited in the Indian Museum, obtained from the alluvia of Assam and Madras; those from the former locality are in a highly mineralised condition. Molars of the Indian elephant have been obtained in the alluvium of the plains of India, and in that of the delta of the Irawadi. A last upper molar of *Rhinoceros indicus* has been obtained by Mr. Foote in the alluvium of Madras: this specimen is very interesting as shewing the former range of that species far to the south of its present habitat, which Jerdon gives as "the Terai from Bhotan to Nepal." *Sus*

* The smaller Liberian hippopotamus (*Chæropsis*) has only two lower incisors.

† The authority for introducing this species in the Narbada fauna is the specimen drawn in plate LXX, fig. 8. of the F. A. S.

indicus has also been obtained by Mr. Foote in the same formation. *Antilope cervicapra* is represented by a fossil horn-core in the Indian Museum whose exact locality is uncertain. Antlers, horn-cores, and teeth of species of *Bos* and *Cervus* have been obtained from alluvia of various parts of the plains, and from raised beaches on the Kattiawar (Kattywar) coast; as, however, these specimens are not yet specifically determined, no more can be said about them.

LIST OF THE FOSSIL VERTEBRATA OF INDIA AND BURMA.

The following list exhibits in a systematic form all the well-established species of Indian and Burman fossil vertebrata, together with the best authenticated of the unnamed species with which I am acquainted. For the great divisions of geological times, the terms Anthropozoic (Age-of-Man), Theriozoic (Age-of-Mammals), Saurozoic (Age-of-Reptiles), and Ichthyozoic (Age-of-Fishes), have been employed in lieu of the old terms Post-Tertiary, Kainozoic, Mesozoic, and Palæozoic, as being more applicable to a chronology of vertebrate evolution, and as forming a series of symmetrical terms.

I. ANTHROPOZOIC (POST-TERTIARY).

1. RECENT ALLUVIA.

MAMMALIA. PRIMATES.	<i>Homo</i> (<i>sapiens</i> ?).	Plains.
	<i>Macacus rhesus</i> .	Gúlpara and Madras.
PROBOSCIDA.	<i>Euelephas indicus</i> .	India and Burma.
UNGULATA.	<i>Rhinoceros indicus</i> .	Madras.
	<i>Sus indicus</i> .	Madras.
	<i>Cervus</i> .	Kattiawar.
	<i>Antilope cervicapra</i> .	Ganges Valley. (?)
	<i>Bos</i> . sp.	Kattiawar and Plains.
REPTILIA. CHELONIA.	?	(plates) Calcutta.
	Other undetermined remains of, probably, recent species.	

2. PLEISTOCENE.

MAMMALIA. PRIMATES.	<i>Homo</i> . sp.	Narbada (weapons) and Madras (weapons and bones).
CARNIVORA.	<i>Ursus namadicus</i> .	(F. and C.) Narbada.
PROBOSCIDA.	<i>Euelephas namadicus</i> .	(F. and C.) Narbada.
	<i>Stegodon ganesa</i> .	(F. and C.) Narbada.
	———— ? <i>insignis</i> .	(F. and C.) Narbada.
	? <i>Mastodon pandionis</i> .	(Falc.) Deccan.
UNGULATA.	<i>Rhinoceros deccanensis</i> .	(Foote.) Deccan.
	———— <i>indicus</i> .	(Cuv.) Narbada.
	———— <i>namadicus</i> .	(F. and C.) Narbada.
	<i>Equus namadicus</i> .	(F. and C.) Narbada.

- MAMMALIA. UNGULATA. Hippopotamus namadicus. (F. and C.) Narbada.
 ————— palæindicus. (F. and C.) Nar. and J.
 ————— sp. P: G.
 Sus giganteus. (F. and C.) Narbada.
 Cervus sp. (? duvancellii) (Narbada).
 Bubalus palæindicus (F. and C.) Narbada and J.
 Bos namadicus. (F. and C.) Narbada. P: G.
 and (?) Deccan.
 Leptobos frazeri. (Rüt.) Narbada.
 Portax namadicus. (Rüt.) Narbada. and P: G.
 RODENTIA. Mus. sp. Narbada.
 REPTILIA. CROCODILIA. Crocodilus (?) sp. Narbada.
 CHELONIA. Pangshura tectum. (Bell. sp.) Narbada.
 Batagur (? dhongoka) Narbada.
 Trionyx (? gangeticus.) Narbada.

II. THERIOZOIC (KAINOZOIC.)

1. PLIO-MIOCENE.

- MAMMALIA. PRIMATES. Palæopithecus sivalensis. (Lyd.) S.
 Macacus sivalensis. (Lyd.) S.
 ————— sp. S.
 Semnopithecus subhimalayanus. (Myr.) S.
 ————— sp. S.
 CARNIVORA. Felis cristata. (F. and C.) S.
 ——— grandicristata. (Bose.) S.
 ——— sp. S.
 Machairodus sivalensis. (F. and C.) S.
 ————— palæindicus. (Bose.) S.
 Pseudælorus sivalensis. (Lyd.) S.
 Ictitherium sivalense. (Lyd.) S.
 Viverra bakerii. (Bose.) S.
 Hyæna sivalensis. (F. and C.) S.
 ——— felina. (Bose.) S.
 Canis curvipalatus. (Bose.) S.
 ——— cautleyi. (Bose.) S.
 Amphicyon palæindicus. (Lyd.) S. Sd.
 Ursus. sp. S.
 ——— sp. I.
 Hyænarcos sivalensis. (F. and C.) S. Sd.
 ————— palæindicus. (Lyd.) S.
 Mellivora sivalensis. (F. and C.) S.
 Meles, sp. (Lyd.) S.

- MAMMALIA. CARNIVORA. *Lutra palæindica*. (F. and C.) S.
Enhydriodon sivalensis. (F. and C.) S.
- PROBOSCIDA. *Euelephas hysudricus*. (F. and C.) S.
Loxodon planifrons. (F. and C.) S.
Stegodon ganesa. (F. and C.) S.
 ——— *insignis*. (F. and C.) S.
 ——— *bombifrons*. (F. and C.) S.
 ——— *cliftii*. (F. and C.) S.
Mastodon sivalensis. (F. and C.) S.
 ——— *latidens*. (F. and C.) S. I. Sd. P.
 ——— *perimensis*. (F. and C.) S. Sd. P.
 ——— *pandionis*. (F.) Sd. S. P.
 ——— *falconeri*. (Lyd.) Sd. S.
Dinotherium indicum. (Falc.) S. P.
 ——— *pentapotamiæ*. (Falc.) S.
 ——— *sindiense*. (Lyd.) Sd. S.
- UNGULATA. { *Chalicotherium sivalense*. S. Sd.
 { *Rhinoceros iravadicus*. (Lyd.) I.
 { ——— *palæindicus*. (F. and C.) S.
 { ——— *platyrhinus*. (F. and C.) S.
 { ——— *sivalensis*. (F. and C.) S. Sd.
 { ——— sp. Tibet.
 { *Acerotherium perimense*. (F. and C.) P. Sd. S. I.
 { *Listriodon pentapotamiæ*. (Falc. sp.)
 { ——— *theobaldi*. (Lyd.) S.
 { (?) *Tapirus*, sp. (Clift.) I.
 { *Equus sivalensis*. (F. and C.) S.
 { ——— sp. Tibet.
 { *Hippotherium antilopinum*. (F. and C.) S.
 { ——— *theobaldi*. (Lyd.) P. S. Sd.
 { ——— sp. Tibet.
- Artiodactyla. { *Hippopotamus iravadicus*. (F. and C.) I.
 { ——— *sivalensis*. (F. and C.) S.
 { *Tetraconodon magnum*. (Falc.) S.
 { *Sus giganteus*. (F. and C.) S.
 { — *hysudricus*. (F. and C.) S. P. Sd.
 { — *punjabiensis*. (Lyd.) S.
 { *Hippohyus sivalensis*. (F. and C.) S.
 { ——— sp. S.
 { *Sanitherium schlagintweitii* (Myr.) S.
 { *Hyotherium sindiense* (Lyd.) Sd.
 { *Anthracootherium silistrense*. (Pent.) Sy. S. Sd.
 { *Hyopotamus palæindicus*. (Lyd.) Sd.

- MAMMALIA. UNGULATA. { Merycopotamus dissimilis. (F. and C.) S.
 Chæromeryx silistrensis. (Pom.) Sy.
 Hemimeryx, sp. (Lyd.) Sd.
 Sivameryx, sp. (Lyd.) Sd.
 Cervus triplidens. (Lyd.) S.
 ——— sivalensis. (Lyd. Mss.) S.
 ——— simplicidens. (Lyd.) S.
 ——— (?) latidens. (Lyd.) S.
 Dorcatherium majus. (Lyd.) S.
 ——— minus. (Lyd.) S.
 Palæomeryx, sp. (Lyd.) S. Sd. (?)
 Camelopardalis sivalensis. (F. and C.) S. P.
 ——— sp. S.
 Hydaspitherium grande. (Lyd.) S.
 ——— leptognathus. (Lyd.) S.
 ——— megacephalum. (Lyd.) S.
 Bramatherium perimense. (Falc.) P.
 Sivatherium giganteum. (F. and C.) S.
 Vishnutherium iravadicum (Lyd.) I. S. (?)
 Antilope palæindica. (F. and C.) S.
 ——— patulicornis. (Lyd.) S.
 ——— porrecticornis. (Lyd.) S.
 ——— sivalensis. (Lyd.) S.
 ? Palæoryx, sp. (Lyd.) S.
 Portax, sp. (Lyd.) S.
 Hemibos occipitalis. (Falc. sp.) S.
 ——— acuticornis. (Falc. sp.) S.
 ——— antilopinus. (Falc. sp.) S.
 Leptobos falconeri. (Rüt.) S.
 Bubalus platyceros. (Lyd.) S.
 ——— palæindicus. (F. and C.) S.
 Bison sivalensis. (Falc. MSS.) S.
 Bos acutifrons. (Lyd.) S.
 ——— planifrons. (Lyd.) S.
 ——— platyrhinus. (Lyd.) S.
 Bucapra daviesii. (Rüt.) S.
 Capra perimensis. (Lyd.) P.
 ——— sivalensis. (Lyd.) S.
 ——— sp. (Lyd.) S.
 ? Ovis, sp. (Blyth.) S. T.
 { Camelus sivalensis. (F. and C.) S.

Artiodactyla.

- MAMMALIA. RODENTIA. Mus. sp. S.
Rhizomys sivalensis. (Lyd.) S.
Hystrix sivalensis. (Lyd.) S.
- AVES. EDENTATA. Manis sindiensis. (Lyd.) Sd.
CARINATÆ. Graculus (?), sp. (Dav.) S.
Pelecanus cautleyi. (Dav.) S.
———— ? sivalensis. (Dav.) S.
Megaloscelornis sivalensis (Lyd.)
Megaloscelornis. (?) sp. Sd.
Argala falconeri (M. Ed.) S.
- RATITÆ. Struthio asiaticus. (M. Ed.) S.
Dromæus sivalensis. (Lyd.) S.
Gen. indet. (Brit. Mus. Col.) S.
- REPTILIA. CROCODILIA. Crocodilus palustris (Less.) S. P.
———— sp. I.
Gharialis gangeticus (Gmel.) S. Sd. I.
———— leptodus (F. and C.) S.
———— crassidens. (F. and C.) S. Sd.
- LACERTILIA. Varanus sivalensis. (Falc.) S.
- OPHIDIA. Gen. indet. S. Sd.
- CHELONIA. Colossochelys atlas. (F. and C.)
Testudo (?), 5 sp. S.
Bellia sivalensis. (Theo.) S.
———— sp. S.
Damonia hamiltonoides. (Falc. sp.) S.
Emys, sp. S.
Cautleya annuliger. (Theo.) S.
Pangshura tectum. (Bell. sp.) S.
Batagur, sp. S.
Trionyx, sp. S. I. P.
Emyda vittata. (Pet.) S.
———— sp. S. I. P.
- PISCES. ELASMO-BRANCHII. Carcharias, sp. I.
Lamna, sp. Sd.
? (vertebræ.) P.
? (palatal teeth) S. Sd.
- TELEOSTEI. Chaca (?), sp. S.
? (vertebræ.) S. Sd.

2. EOCENE (INTRATRAPPEAN AND NUMMULITIC).

- MAMMALIA. UNGULATA. (perissodactyle femur). Punjáb.
(artiodactyle astragalus) Punjáb.

REPTILIA.	CROCODILIA.	(teeth and vertebræ) Punjáb.
	CHELONIA.	Hydraspis leithii (Carter sp.) Bombay.
BATRACHIA.	ANOURA	Oxyglossus pusillus. (Owen. sp.) Bombay.
		————— (?) sp. Bombay.
PISCES.	ELASMOBRAN-	
	CHII.	Myliobatis, sp. (Lyd.) Punjáb.
	TELEOSTEI.	Diodon foleyi, (Lyd.) Ramri I. and Pt. Blair.
		Capitodus indicus. (Lyd.) Punjáb.
		? (Cycloid scales) Nr. Thayetmyo.

III. SAUROZOIC (MESOZOIC).

1. CRETACEOUS SERIES.

REPTILIA.	DINOSAURIA.	Megalosaurus, sp. (Lameta and Trichinopoli)
		Titanosaurus blanfordi. (Lyd.) Lameta gp.
		————— indicus. (Lyd.) Lameta gp.
		? (unknown reptile.) Lameta gp.
	CROCODILIA.	(amphicælian sp.) (Lyd.) Sind.
	CHELONIA.	? (plates.) Lameta, Rajamahendri, and Sind.
	ICHTHYOSAURIA.	Ichthyosaurus indicus. (Lyd.) Trichinopoli.
PISCES.	ELASMOBRANCHIL.	Corax incisus. (Eg.) Trichinopoli.
		———— pristodontus. (Ag.) Trichinopoli.
		Enchodus serratus. (Eg.) Trichinopoli.
		Lamna complanata. (Eg.) Trichinopoli.
		———— sigmoides. (Eg.) Trichinopoli.
		Odontaspis constrictus. (Eg.) Trichinopoli.
		———— oxypeion. (Eg.) Trichinopoli.
		Otodus basalis. (Eg.) Trichinopoli.
		———— divergens. (Eg.) Trichinopoli.
		———— marginatus. (Eg.) Trichinopoli.
		———— minutus. (Eg.) Trichinopoli.
		———— nanus. (Eg.) Trichinopoli.
		———— semiplicatus. (Eg.) Trichinopoli.
		Oxyrhina triangularis. (Eg.) Trichinopoli.
		———— sp. (Stol.) Trichinopoli.
		Ptychodus latissimus. (Ag.) Trichinopoli.
	GANOIDEI.	Pycnodus (?), sp. (Stol.) Trichinopoli.
		? ? (scales) Lameta.
		? ? (scales) Intratrappean. Rajamahendri.

2. JURA-TRIASSIC SERIES.

REPTILIA.	DINOSAURIA.	Ankistrodon indicus (Hux.) Panchet gp.
	CROCODILIA.	(amphicælian sp.) (Lyd.) Chari gp.

REPTILIA.	CROCODILIA.	Parasuchus, sp. (Hux.) (hislopii. MSS.) Maleri gp.
		—— ? sp. (Lyd.) Denwa gp.
	LACERTILIA.	Hyperodapedon, sp. (Hux.) Maleri gp.
	DICYNODONTIA.	Dicynodon orientalis. (Hux.) Panchet gp. ——— sp. Panchet gp.
	PLESIOSAURIA.	Plesiosaurus indicus (Lyd.) Umia. gp.
BATRACHIA.	LABYRINTHODONTIA.	Brachyops laticeps. (Ow.) Mangli. gp. Gonioglyptus longrostris. (Hux.) Panchet gp. Pachygonia incurvata (Hux.) Panchet gp. Archegosaurus (?) Bijori gp.
PISCES.	DIPNOI.	Ceratodus hislopianus. (Old.) Maleri gp. ——— hunterianus. (Old.) Maleri gp. ——— virapa. (Old.) Maleri gp.
	GANOIDEI.	Dapedius egertoni. (Syk.) Kota gp. Lepidotus breviceps. (Eg.) Kota gp. ——— calcaratus. (Eg.) Kota gp. ——— deccanensis. (Eg.) Kota gp. ——— longiceps. (Eg.) Kota gp. ——— pachylepis. (Eg.) Kota gp. Tetragonolepis analis. (Eg.) Kota gp. ——— oldhami. (Eg.) Kota gp. ——— rugosus. (Eg.) Kota gp.
	?	? (Scales) Sripermatúr gp. Kota gp.

IV. ICHTHYOZOIC (PALÆOZOIC).

1. CARBONIFEROUS.

PISCES.	GANOIDEI.	Sigmodus dubius. (Waag.) Salt-range.
	ELASMOBRANCHII.	Pœcilodus paradoxus. (Waag.) Salt range. Psephodus indicus. (Waag.) do. Helodopsis elongata. (Waag.) do. ——— abbreviata. (Waag.) do. Psammodus, sp. do. Petalorbyncus indicus. (Waag.) do. Xystracanthus gracilis. (Waag.) do. ——— major. (Waag.) do. ——— giganteus. (Waag.) do. Thaumatacanthus blanfordi. (Waag.) do.

Abbreviations used in the above.

Ag. = Agassiz ; Dav. = Davies ; Eg. = Egerton ; F. and C. = Falconer and Cautley ; Gmel. = Gmelin ; Hux. = Huxley ; I. = Irawadi

(Irrawaddy) valley, Burma; J. = Jamna; Less. = Lesson; Lyd. = Lydekker; M. Ed. = Milne-Edwards; Myr. = Herman von Meyer; Old. = Oldham; Ow. = Owen; P. = Perim Island, gulf of Cambay; Pent. = Pentland; P. G. = Pem-ganga; Pet. = Peters; Pom. = Pomel; Rüt. = Rüttimeyer; S. = Siwaliks (including Punjáb); Sd. = Sind; Stol. = Stoliczka; Sy. = Sylhet; Syk. = Sykes; T. = Tibet; Theo. = Theobald; Waag. = Waagen.

CONCLUSION.

In the foregoing sketch of the fossil vertebrata of India, but few new facts have been recorded, and, indeed, the main objects in penning it were the hope, firstly, of inducing persons interested in scientific enquiries to aid us in our endeavours to increase our knowledge of this interesting branch of science, and, secondly, of making one of those landmarks, so necessary in an ever-increasing subject like the present, from whence new advances can again be made. With regard to the first object, it may be observed that District Officers in India, and other officials, in the course of their periodical professional tours through the country, have far greater opportunities of collecting the larger and more conspicuous fossils than can possibly fall to the lot of the officers of the Geological Survey of India, who are few in number, and who, for years together, are not called upon to visit many parts of the country. To all who have opportunities of travelling through unfrequented parts of India likely to contain fossil remains, the appeal is here made for assistance in our endeavours to obtain a more complete knowledge of the fossil vertebrata of India. Any fossils sent to the Superintendent of the Geological Survey of India (Calcutta) will be most gratefully received, and, after comparison or description, either returned to their owners, or, if presented, carefully preserved in the collection of the Indian Museum.

Note.—Additions to this paper have been made while it was passing through the press, bringing it up to date.



Lydekker, Richard. 1880. "IV.—A Sketch of the History of the Fossil Vertebrata of India." *The journal of the Asiatic Society of Bengal* 49(I), 8–40.

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