of the Rajmahal flora as at least lower Liassic. The *Estheria* may perhaps be taken as an indication in the same direction. This *Estheria Kotaensis* may now also be taken as an Upper Gondwana form.

As the *Estheria* has hithero been neglected in India in the discrimination of horizons' I would add some illustrations of the service it has rendered elsewhere.

Estheria minuta, Jones, is a splendidly guiding fossil of the whole *Keuperic* strata in Europe. A variety of this species—*Esth. minuta*, var. *Brodieana*, J.—is characteristic of the Rhætic strata. The well-known Prof. Römer, only with the assistance of *Estheria minuta*, var. *Brodieana*, Jon., decided that certain rocks in Upper Silesia belong to the Rhætic group. He says in his valuable work, "Geologie von Oberschles," on p. 175, discussing the fossils of certain series, which he calls "Hellwalder Estherien Schichten," as follows (I give the translation):—"Except *Estheria minuta*, Jones, no organisms were observed in that series. But also by itself the little crustacean is of great importance for the determination of the age of this formation. *Estheria minuta*, J., is a very common fossil in the Keuper. A variety, *Esth. minuta*, var. *Brodieana*, J., which is marked by a smaller size and a finer reticulation in the sculpture of the shell, is according to Jones' explanation characteristic of the Rhætic strata. The Upper-Silesian form agrees very well with the figures of this variety." And from this and from some other characteristics, Prof. Römer draws the correct conclusion that those beds in Upper Silesia alluded to are of Rhætic age.

Our *Estheria* of the smaller size does not differ much from that Silesian one. Thus, two species are characteristic of certain series; and there are more of them.

Now Prof. Geinitz describes *Estheria Mangaliensis*, Jones, again from Rhætic strata, in South America. Prof. Rupert Jones has certainly not in vain devoted a monograph to the fossil *Estheria*.

NOTICES OF NEW AND OTHER VERTEBRATA FROM INDIAN TERTIARY AND SECONDARY ROCKS, *by* R. LYDEKKER, B. A., *Geological Survey of India.*

The present paper contains short notices of several species of Vertebrata from the Tertiaries and Secondaries of India, which are either new to science, or of which some new point in the osteology or distribution is now for the first time noticed; the new species will be subsequently figured and described in the "Palæontologia Indica," although some of these descriptions will not appear for a considerable period.

BOS ACUTIFRONS, n. sp., nobis.

This species is founded upon a cranium from the Siwaliks; it may be defined from the characters of the cranium as follows:—

Frontals convex, longer than broad, horn-cores placed immediately above occiput, compressed, convex superiorly, extending at first upwards and outwards, with a slightly inward curve at their tips; centre of forehead more prominent than bases of horn-cores; span of horn-cores when complete nearly nine feet; occipital crest narrow, rounded, and extending upwards almost to the intercornual ridge.

BOS PLANIFRONS, n. sp.

This species also is known by a single cranium from the Siwaliks, of smaller size than the last; it may be defined as follows:—

Frontals nearly flat, longer than broad, horn-cores placed above occiput, slightly compressed, convex superiorly directed outwards, slightly upwards, and at the tips inwards;

centre of forehead not in advance of bases of horn-cores; the latter shorter than in last species; occipital crest broad and narrowed, and separated by a considerable interval from the intercornual ridge.

BUBALUS PLATYCEROS, n. sp., nobis.

Frontals nearly flat, rounded superiorly, horn-cores triangular, placed in advance of the plane of the occiput, superior border concave, directed upwards and outwards, tapering rapidly, widely separated at their bases; exterior face continuous with the plane of the frontals; occipital crest broad and rounded, entirely distinct from the intercornual ridge This species is also from the Siwaliks.

STEGODON GANESA, F. & C.

A tusk of this species from Biltari in the Nerbudda valley has been for a long period in the Indian Museum, though the species has never been described from the Nerbudda deposits; it comprehends the greater portion of the middle part, and is from the left side; it is characterized by being laterally compressed, and by the extremity curving upwards and inwards; in the above points, and in its size, it exactly corresponds with the tusk of Colonel Baker's cranium of *S. ganesa*. The dimensions are as follows:—

	Feet.	Inches.
Length of fragment along concave upper border	6	7
Length of chord of arc	6	1
Vertical diameter near proximal extremity	0	8·5
Transverse ditto ditto	0	7·3
Vertical diameter at distant extremity	0	6·7
Transverse ditto ditto	0	4·7

The base of the tusk is absent, and must have been of considerably larger diameter than our fragment, perhaps as large as that of the tusk of Colonel Baker's specimen of this species, which has a vertical diameter of nearly ten inches. The tusks of *S. insignis* are never more than three or four inches in diameter, while those *Elephas namadicus* are usually of about that size, but are occasionally larger. The largest known cranium of the latter species is in the Indian Museum; it is described by Dr. Falconer in the Catalogue of the Asiatic Society's Collection, p. 235. The largest diameter of the incisive sheath of that specimen is 6·6 inches; this being the transverse diameter, the vertical diameter is somewhat smaller. The shape of the incisive sheath, as well as its small size, shews that the tusk in question could not have belonged to *Elephas namadicus*, since the above-mentioned cranium, of the latter species, in the Indian Museum, belonged to an unusually large individual. The cranium to which the tusk under discussion belonged must have had an incisive alveolus, of which the vertical diameter was at least nine and a half inches. The exact agreement, both in form and size, of our specimen with the left tusk of Colonel Baker's gigantic cranium of *Stegodon ganesa*, now in the British Museum, is of itself amply sufficient to prove that our Nerbudda specimen belonged to that species. We have no complete tusks of *Elephas namadicus* in the Indian Museum, but such fragments as we possess indicate that these tusks were nearly straight and cylindrical, and therefore quite unlike the present specimen. The large size of our specimen sufficiently distinguishes it from *Stegodon insignis*.

The range in time of *Stegodon ganesa* must now be made equivalent to that of the allied *Stegodon insignis*, which lived down to the Nerbudda period, and must have been a contemporary of the early human inhabitants of India.

SIVALHIPPUS THEOBALDI, n. gen., nobis.

This genus is formed upon the evidence of a portion of the left maxilla with teeth of an aberrant horse lately sent down by Mr. Theobald from the Siwaliks of Keypar in the

Punjab. The specimen contains the four anterior teeth of the molar series, which have only just come into wear; only a short notice is here given of these teeth, as they will subsequently be figured and fully described.

The first premolar is very small; it is inserted by a single fang; the three succeeding teeth are inserted by distinct fangs, and their crowns are consequently extremely short; their grinding surfaces are oblong, their antero-posterior diameter being the longer of the two; the second tooth is elongated. The larger teeth consist of six lobes, of which the outer and middle pairs are the larger, the latter pair being concave externally; the antero-internal lobe is placed between the two median lobes, and is entirely unconnected with them; the postero-internal lobe is connected by a narrow bridge with the postero-median lobe; the medial enamel infolds are deeply crenulated, and all the hollows are filled with cement; the length of the three large teeth is 3·05 inches; the length of the penultimate tooth is 1·25 inches, and its breadth 0·9 inch.

The teeth approach nearest to those of *Hippotherium*, but are distinguished among other characters by their elongated crowns, and by being inserted by distinct fangs as soon as they are protruded; in the latter character they agree with the American *Protohippus* and *Merychippus*, but are distinguished by having the antero-internal column detached from the antero-median column.

The completeness of the median columns distinguishes these teeth from those of *Anchitherium* and its kindred.

The generic name is derived from the name of the beds in which the specimen was found, and the specific name is given after Mr. Theobald, the discoverer of this and so many other Siwalik fossils.

An examination of the remains of Siwalik *Equidæ* in the Indian Museum has convinced me that, besides the above new genus, there are two species of true *Equus* from these deposits,—namely, *E. sivalensis*, and a new species; and that there are also two species of *Hippotherium*,—namely, *H. antilopinum*, and a larger new species. Two detached middle molars of the latter species are figured by H. von Meyer in the fifteenth volume of the German Palæontographica, under the name of *Equus primigenius* (=*Hippotherium gracile*); a more complete series of the dentition of this species enables me to state that it is certainly distinct from the European species, which must consequently be expunged from the lists of Indian fossils. A memoir on the dentition of all the Indian fossil *Equidæ*, in which the new species will receive names, will subsequently appear.

Ictitherium Sivalense, n. sp., nobis.

The above genus of Viverroid carnivores was first made known to science by M. Gaudry, who determined two species from the upper miocene of Attica; two fragments of the mandible of a Viverroid carnivore, lately sent down by Mr. Theobald from the Siwaliks of the Panjab, appear to agree very closely with the lower jaw of the European *I. robustum*, and I have accordingly referred them to that genus with the specific name of *sivalense*.

The two fragments are respectively from the right and left sides, and probably belonged to the same individual; the larger of the two comprehends the hinder half of the left ramus, lacking the condyle and the coronoid and angular processes; it shews the sectorial molar, the socket of the second molar, and the greater part of the ultimate premolar; the smaller fragment comprises a portion of the middle of the right ramus shewing the two last premolars.

The jaw is arcuated on the inferior border, and is of great depth; the sectorial molar has two outer lobes,—an accessory lobe on the inner side of the second of these lobes, and a talon; the premolars have the same general form as in *Ictitherium;* the crown of the last molar is not shewn. The length of the sectorial molar is 0·7 inch, of the last premolar 0·57; the depth of the jaw is 0·97 inch; the specific differences between this species and *I. robustum* will be subsequently pointed out.

The lower jaw of this genus is distinguished from that of *Hyæna* by the presence of two molars; from *Gulo* and *Putorius* by the presence of the inner lobe on the sectorial; the dental formula of *Ictitherium* is the same as in *Martes* and *Vivena*, but the jaws of the two latter genera are much more slender, and the form of the teeth is also somewhat different.

Dinotherium and Antoletherium.

Among a collection of specimens lately received in the Indian Museum from the Asiatic Society, the original lower jaw, from a drawing of which Dr. Falconer founded the genus *Antoletherium*, has been discovered. Dr. Falconer's notes on the drawing will be found in the "Palæontological Memoirs" (vol. I, p. 416), where a copy of Colonel Baker's drawing is also given (Pl. 34). This drawing, however, is incorrect; the centre tooth (B) should have three in place of two transverse ridges, while the tooth on the right (C) should have but one ridge. From a note on page 417 of the Palæontological Memoirs it seems that Dr. Falconer subsequently received a correct sketch.

In the same collection, I have also found a portion of a lower jaw with two slightly worn molars from the Siwaliks, which undoubtedly belongs to *Dinotherium*, but which is remarkable for having an incomplete longitudinal ridge between the transverse ridges of the molars, which when worn down would resemble the pattern of the molars of the so-called *Antoletherium;* a smaller and less complete ridge is found in the lower molars of *Dinotherium giganteum*. No other animal but *Dinotherium* has a single three-ridged tooth between two-ridged teeth, as occurs in the so-called *Antoletherium*.

I think that there can be no doubt but that the lower jaw, to which the name of *Antoletherium* has been applied, really belongs to *Dinotherium*, and that the former name must be abolished. The central tooth (1st molar) of the Attock jaw agrees precisely in size with the first upper molar of a *Dinotherium* from the same locality noticed by Falconer, on page 414 of the first volume of the "Palæontological Memoirs," and which I have figured as *D. pentapotamiæ* in a forthcoming number of the "Palæontologia Indica:" the two doubtless belong to the same species. The jaw in question affords additional proof of the specific distinctness of the Punjab *Dinotherium;* both of the re-discovered specimens will be subsequently figured in the "Palæontologia Indica."

Hyænarctos Sivalensis, Falc. and Cant.

Mr. Theobald has lately sent down a nearly perfect mandible of this species, which is exceedingly important, as it shews that, from the incompleteness of his specimen, Professor Owen was led astray in assigning the teeth to their proper position in the series. The new specimen shews the three true molars, and the sockets of the premolars; the last molar has a circular crown, and is not shewn in the specimen figured by Professor Owen in his Odontography (Pl. 131). From the absence of this tooth, Professor Owen considered the second molar as the last of the series, the carnassial as the second molar, and the last premolar as the carnassial (*Odontography*, p. 504). The new specimen shews that the carnassial is much larger than any of the other teeth, and that the form of the last molar agrees more nearly with the same tooth in the true Bears than was the case according to Professor Owen's interpretation of the homologies of the teeth. A figure of the new specimen will appear in the "Palæontologia Indica."

MERYCOPOTAMUS DISSIMILIS, Falc. and Cant.

Since publishing my notes on the Osteology of this genus, in the last volume of the "Records" (p. 144), I have had an opportunity of comparing the axis vertebra and the astragalus of *Merycopotamus* with the corresponding bones of *Hyopotamus bovinus* from the upper eocene of Bracklesham, and find that these bones of the two genera are so close in form as to be almost undistinguishable one from the other, and were it not for the evidence of the skull and teeth, they would at once be referred to the same genus. I give here the dimensions of the axis and astragalus of *Hyopotamus*, which may be compared with those of the same bones of *Merycopotamus* given on pages 151 and 152 of the last volume of the "Records":—

Axis Vertebra.

	Inches.
Length of centrum	2·9
Width of posterior surface of ditto	1·2
Depth of ditto	9·5
Width across anterior articular facet	2·6
Length of odontoid process	6·8
Width of ditto	6·9

Astragalus.

Extreme length	2·3
Width across tibial trochlea	1·1
Ditto distal extremity	1·3
Width of cuboidal articular facet	0·64
Ditto navicular ditto	0·66
Length of calcaneal trochlea	1·3
Width of ditto	0·7

I have not had an opportunity of comparing any other of the limb bones of *Hyopotamus* with those of *Merycopotamus*, but the figures of the bones of the foot of the former genus seem to be very like the corresponding bones of *Merycopotamus*.

The above resemblances serve to shew that *Merycopotamus* must be a survivor of a very ancient type of structure; and also shew that the genus has affinities on the one hand as shewn by teeth and limb bones with the *Hyopotamidæ*, and on the other, as shewn by its skull and lower jaw, with the *Hippopotamidæ*.

PARASUCHIAN CROCODILE.

Mr. Hughes has lately sent in a specimen of a scute of a Crocodilian from the Dénwa group of the Mahadeva series, collected by him on the banks of the Dénwa river. The specimen is of importance, as hitherto no fossils have been obtained from these beds. I hope on a subsequent occasion to give a figure of this scute, and therefore at present shall only roughly describe it. The specimen is of large size, being at the centre more than an inch in thickness; it seems to have belonged to the dorsal series of scutes, and is from the right side; it is fractured through its centre, the longitudinal ridge being broken away; externally, it is convex from side to side; the inner border presents a flat surface for sutural union with its fellow of the opposite side; the posterior border is bevelled away inferiorly and overlapped the anterior border of the succeeding scute; a great part of the anterior moiety has been broken away. The upper surface is deeply pitted, and the peripheral pits are expanded into elongated grooves presenting a radiating arrangement. The specimen when complete was probably as large as broad, and indicated an animal of gigantic dimensions; the length of the one complete (inner) border is 6·1 inches. The above-mentioned characters shew that the specimen belonged to the Amphicœlian Crocodilia so characteristic of the

mesozoic period. (See Huxley, Q. J. G. S., Vol. XV, p. 446.) At the anterior border of the specimen there is a smooth hollow on the inferior surface, which may possibly have received the extremity of a long peg from the anterior scute. A similar arrangement occurs in the scutes of *Goniopholis crassideus* of the English Purbeck; but in that genus the peripheral pits are not elongated as in our specimen, and have consequently no radiate arrangement.

The form of the pits and the articulations of the two remaining lateral surfaces agree very closely with those of the dorsal scutes of *Belodon* from the upper Keuper and Rhætic of Würtemburg,* and the arrangement of the pitting also agrees very closely with that which covers the scutes of the allied Indian genus *Parasuchus*, from the Kota-Maléri beds. The present specimen is, however, of very much larger size than any specimens of the scutes of that genus from those beds, although we have vertebra in the Indian Museum from those same beds which belonged to an individual which might not have been very much smaller than that to which the Denwá scute belonged. I think we may safely say that the above scute belonged to the group of Crocodilia Parasuchia, and very probably to the genus *Parasuchus*, but that the species was probably distinct from the Kota-Maléri species.

We have, in the Indian Museum, from a third distinct locality, an amphicœlous vertebra of a crocodile from the Chari beds of Kach, which is considerably like those from the Kota-Maléri beds.

This vertebra has an elongated and laterally compressed centrum, somewhat expanded at the ends; the articular surfaces are vertically elliptical and hollowed; there are large transverse processes, and a well-developed neural spine; the zygapophyses are concealed by matrix. The neurocentral suture is clearly marked and is placed considerably below the transverse process, the latter consequently rising entirely from the arch; this shews that the vertebra belonged to the posterior dorsal series, the rib not articulating with the centrum. The vertebra could only belong to the *Crocodilia Amphicœlia* or the *Plesiosauria*; the dorsal vertebræ of the latter order are, however, cylindrical and generally shorter than the present specimen, the proportion of the long diameter to the transverse diameter being in the Macrospondylian Plesiosauri never more than in the proportion of 10 to 8, while in the present specimen these two diameters are in the proportion of more than 2 to 1. A similar proportion prevails in the vertebræ of many of the Amphicœlian crocodiles, to which group our specimen must belong. The dimensions of the specimen are—

	Inches.
Length	... 3·1
Breadth of centrum (transverse)	... 1·4
Height of centrum	... 1·65

The specimen has already been referred to by Dr. Feistmantel† as belonging to the genus *Parasuchus*. I am not, however, quite sure whether this is the case, but I think it is almost certain that the vertebra in question belonged to the *Crocodilia Parasuchia* and quite possibly to *Parasuchus*; it will require the discovery of scutes in the Chari beds to be quite sure as to the generic position of the vertebra.

If the specimen belongs to *Parasuchus*, it tends somewhat to approximate the horizons of the Chari and Kota-Maléri beds; the former beds have been considered as the equivalents of the Oxfordian and Callovian of Europe; but Dr. Feistmantel has indicated the existence of Liassic forms in these beds, which tend to place them on a somewhat lower horizon than the

* *Von Meyer Palæontographica*, Vol. VII, Pl. 43.

† Rec. Geol. Surv., India. Vol. IX, p. 16.

Oxfordian. In any case, however, the Chari beds must be considered newer than the Trias and the Rhætic, and the occurrence of a (probably) Parasuchian Crocodile in these beds somewhat does away with the value of that group as characteristic of the Trias or Rhætic.

I may here mention that the occurrence of the remains of a fresh-water Crocodile in the marine Chari group is paralleled by the occurrence of the estuarine *Teleosauri* in the marine Lias of Whitby; its presence serves to indicate that the Chari beds were deposited in a sea not far removed from the estuary of some large river.

Having now defined the affinities of our Denwa scute, and noticed the position of other allied forms in the Indian rock-series, we may turn our attention to consider whether it affords us any assistance in fixing the homotaxis of the rocks in which it occurs, during which we shall be led also to consider the age of the Kota-Maléri beds. From the great similarity of structure between the Denwa scute and the scutes of *Parasuchus* from the Kota-Maléri group, with the scutes of the European genus *Belodon*, I am inclined to think that the horizons in which these three forms occur cannot be very far removed in time; and, therefore, that the period of deposition of the two Indian groups must be somewhere near that of the upper Trias or Rhætic of Europe in which *Belodon* occurs.

We may here consider somewhat more closely the range in time of the vertebrates of the Kota-Maléri group; firstly, we find that the group of *Crocodilia Amphicœlia*, which embraces the minor division of the Parasuchia, ranges in Europe from the upper Trias to the Chalk, and is therefore characteristic of the greater part of the Mesozoic period; the smaller divisions of Parasuchia, which in Europe includes the two genera *Belodon* and *Stagonolepis* according to Professor Huxley,* is in that region confined to the Trias. Dr. Feistmantel, however, tells me that some of the beds in which *Belodon* occurs are now classed as Rhætic.

In addition to *Parasuchus*, the Kota-Maléri beds have also yielded remains of *Hyperodapedon*, which seems probably to belong to the Rhynocephala, and which in Europe is confined to the Triassic period. From the same deposits we also have three genera of fish—*Ceratodus*, *Lepidotus*, and *Æchmodus*; the first of these three is represented by the greatest number of species in the Trias of Europe, and is not known before that period; it is, however, found again in the Oolites of Stonesfield, and a solitary surviving species still lingers on in some of the rivers of Queensland. The genus *Lepidotus* in Europe ranges from the Lias to the lower Chalk, but is most common in the former period; the species described by Sir Phillip Egerton from the Kota beds of Hyderabad in the Journal of the Geological Society for 1851 is said to be most nearly allied to the oldest English forms; the genus undoubtedly belongs to a primitive type of fish; the genus *Æchmodus* in Europe is exclusively Liassic.

The following table represents the distribution of the above-mentioned genera:—

			Europe.					India.		
			Trias.	Rhæt.	Lias.	Oolite.	Cret.	Kota.	Denwa.	Chari.
Parasuchia	Belodon	...	×	×	...	...	...	...	...	...
	Parasuchus	...	...	...	...	...	..	×	×	× ?
	Stagonolepis	...	×	...	...	...	...	...	...	...
Rhynocephala	Hyperodapedon	...	×	...	...	...	...	×	...	...
Pisces	Ceratodus	...	×	...	...	×	(living)	×	...	...
	Lepidotus	...	...	...	...	×	×	×	...	...
	Æchmodus	...	...	...	...	×	...	×	...	...

* Quar. Jour. Geol. Soc., 1875, p. 49.

The above table indicates a somewhat long period of time to which to refer the Kota-Maléri and Denwa beds; but I think we are justified in saying that they are not homotaxically older than the upper Trias or newer than the lower or middle Lias of Europe, and that they might, with a fair show of probability, be referred to the Rhætic period, or somewhere very close to that period.

The whole of the vertebrates from the Denwa and Kota-Maléri groups, as well as those from the older Panchet group, were inhabitants either of fresh water or of the land, and therefore indicate either a fluviatile or sub-äerial origin for the groups of rocks in which their remains are embedded.

The following remarks as to how the above determination agrees with the assigned position of the Denwa and Kota-Maléri beds have been kindly added by Mr. Medlicott:—

The Denwa fossil is a very timely find;—directly, as the first fossil from an immense thickness of strata; and indirectly, because, so far as it is identifiable with others from outlying localities, it supplies the all-important test of stratigraphical position, occurring as it does in the fullest continuous section of the Gondwana deposits. In this way it already furnishes a confirmation of the horizon, as very recently determined by Dr. Feistmantel, for the Kota-Maléri beds, and also for his judgment upon the relations of the Jabalpur and Rajmahal groups.

From a fair amount of evidence, Dr. Feistmantel has insisted on the close correspondence between the flora of the Umia zone (the top of the Jurassic series of Kach) and that of the Jabalpur group (the top of the Gondwana series in Central India), both having a strong Bathonien facies. The Rajmahal group he placed lower, the flora having Liassic affinities. The Kota-Maléri beds have hitherto been taken to be on the Panchet horizon, and therefore lower Gondwana. A few plant fossils were lately found in those localities; those from the bone beds were Jabalpur species; and in the underlying beds a Rajmahal plant occurred. The stratigraphical separation not being very decided, the group may be taken as representing the Rajmahal and an overlying zone. From Mr. Lydekker's estimate it would seem that the vertebrate remains are of a somewhat older type than that of the flora.

In the continuous section of the Satpura basin, the Denwa beds occupy an upper-middle position in the great thickness of the upper Gondwana strata, hitherto vaguely spoken of as the Mahadeva series,* between the Jabalpur group and the Bijori beds, which have been sufficiently identified with the Kamthi-Raniganj horizon of the lower Gondwanas in other areas. Several hundred feet of strata, known as the Bagra beds, occur between the Denwa and the Jabalpur beds; and below the Denwa group occurs the great Pachmari sandstone, the base of which has been conjectured as the probable horizon of the Panchets. In this standard section, then, the Denwa fossil confirms in a very satisfactory manner the position independently assigned from the flora for the Kota-Maléri group. If we could venture to press closely such slight evidence, we might conjecture that the Rajmahal group will have to take its equivalent out of the great Pachmari sandstone.

In his independent classification from examination in the field, Mr. Hughes places the Kota-Maléri beds low in the upper Gondwana series; well below the Balanpur coal, which very closely represents the coal in the Jabalpur group of the Satpura region.

If the fossil which Mr. Lydekker doubtfully identifies as *Parasuchian* from Kach should prove to be such, and thus a connecting link with the Kota-Maléri and Denwa horizon, we should have made an important step in extending the parallel between the marine Jurassic series of Kach and the Gondwana series; for that fossil also occurs well below the Umia-Jabalpur horizon, in the Chari on the Katrol group of Dr. Stoliczka's classification.

* Mem. Geol. Survey, Vol. X.

TITANOSAURUS INDICUS, n. gen. nobis.

I have formed the above new genus of *Dinosauria** upon the evidence of a large femur, and two large posterior caudal vertebræ, which are in the Indian Museum, and which were obtained from the Lameta group of rocks. The femur was collected by Mr. Medlicott in the year 1871 from the Lametas of Jabalpur; the vertebræ were also obtained from Jabalpur, and are shortly described in Falconer's "Palæontological Memoirs" (vol. 1, p. 418); the larger of the two is figured on a small scale in Plate 34 of the same work. No reference was, however, made to their affinities or even as to their position in the vertebral series.

I will first extract Dr. Falconer's description of these vertebræ, then compare them with the vertebræ of the other Dinosauria to which they are allied, and finally describe Mr. Medlicott's specimen of the femur. Dr. Falconer states: "The larger vertebræ consists of a compressed body, very considerably compressed sideways, and contracted in diameter between the articular surfaces, both in the vertical and transverse direction. The anterior articulation is elliptical vertically in its outline, and the cup as deep as in the *Crocodilia;* the posterior articulating surface is of a corresponding reversed form, *i. e.*, very convex, flattened laterally, the greatest convexity being towards the middle or axis. The inferior surface of the body at either end bears immediately behind the rim of the cup in front, and in front of the ball behind a pair of surfaces for the articulation of a chevron bone, *i. e.*, each chevron has been articulated to two adjoining vertebræ.

"The spinous process, which is broken off (near the summit), is flattened and of considerable size near the base; it is given off from the body backwards at an angle of about 45°. Between it and the body there is a semicircular niche about 1·2 inches deep. From the anterior part or base of the spinous process two articular apophyses are given up, nearly horizontally, or inclined upwards at a small angle; and diverge, but the divergence is small. The articular surfaces are on the axial side.

"It would appear that the next anterior vertebræ passed its spinous process between these articular surfaces; but no marks of such articulation are seen in the spinous process of the vertebræ.

Dimensions.

	Inches.
Extreme length of body	5·4
Height in middle to hollow between spinous and articulating apophyses ...	4·9
Height of anterior concave end	3·4
Width of ditto	2·4
Length of body from rim to base of ball	4·1
Height of base of ball behind	3·4
Transverse diameter of ditto	2·3
Height of body where constricted behind	2·8
Greatest constriction of ditto	1·3
Length of articular process	2·2
Ditto from base of spinous process to top of ditto	4·0
Length of lamina, right side	1·8
Vertical diameter of spinous process	1·9
Transverse diameter of ditto	0·8

"Vertebral canal small and constricted, not a trace of a suture remaining.

"The other vertebra (unfigured) is shorter and less perfect. The spinous process is broken off at the base, and the articular processes, if any, are gone. The body is shorter and less constricted; there are the same ball and socket ends, but they are not so deep; there are also the two surfaces for chevron bones."

* The term *Dinosauria* is here used in a general sense, as comprehending both the *Ornithoscelida* and the *Sauroscelida* of Professor Huxley.

To the above description I would add that there are no transverse processes; that the neural arch is anchylosed to the anterior half of the upper borders of the centrum, the posterior half of the latter being free; that a longitudinal furrow traverses the hæmal aspect of the centrum; and that the prezygapophyses are cylindriform and project far forwards.

We will now inquire to what animal the vertebræ are likely to belong. Firstly, from the presence of surfaces for the attachment of chevron bones, from the small size of the neural canal, and from the absence of posterior zygapophyses, it is quite clear that the vertebræ belong to the caudal region; and secondly, from the absence of transverse processes, and from the comparatively small size of the neural spine and prezygapophyses, it is clear that they belong to the posterior half of the caudal region.

The only mammalia of large size which have chevron bones attached to the caudal vertebræ are the *Edentata* and the *Cetacea;* in the former order all the caudal vertebræ have transverse processes, and the centrum is short and cylindrical; in the latter the centrum is still shorter and more discoidal. It is therefore clear, independent of their geological position, that the bones do not belong to the mammalia.

Turning now to the reptiles, we find that in the *Crocodilia* and the *Lacertilia* the posterior caudal vertebræ, though procœlous, have a persistent neuro-central suture; the neural arch extends as far back as the centrum; there are both pre- and post-zygapophyses; there is generally a transverse process, and the chevron bones articulate with only one vertebra;—so that each vertebra has only one pair of facets on its hinder border for their articulation. Orders of reptiles such as the *Ichthyosauria*, *Plesiosauria*, *Chelonia*, *Dicynodontia*, etc., have vertebræ of totally different types, and require no comparison with our specimens.

If, however, we turn to the order *Dinosauria*, we find that here we do meet with vertebræ which agree very closely with our present specimens; if we compare the figure of a posterior* caudal vertebra of *Pelorosaurus*, figured on Plate 26 of the Philosophical Transactions for 1850, with Dr. Falconer's figure of the Jabalpur vertebra (the two figures being taken from opposite sides of the bones), we shall find a very great resemblance in many points of essential structure. Firstly, both vertebræ agree in being elongated, in the absence of any transverse process, in having a neural arch of considerable height, in carrying prezygapophyses, but no post-zygapophyses; in the former, being cylindriform and projecting in front of the centrum, and in having a small neural canal; moreover, in both, the neuro-central suture is completely obliterated, while the neural arch does not extend backwards beyond the middle of the centrum, the posterior half of the latter being quite free; both vertebræ likewise have the inferior border of the centrum arched.

Having now considered the points of resemblance, we must point out the differences between our Jabalpur vertebræ and those of *Pelorosaurus*. The most striking difference is that our vertebræ are markedly concave anteriorly and convex posteriorly, whereas those of *Pelorosaurus* are slightly concave anteriorly and nearly flat posteriorly; the latter are also approximately cylindrical, and carry facets for the chevron bones only on the hinder extremity. The caudal vertebræ of Iguanodon (Owen, Brit., Crœt. Rep., Pl. 37) resemble our specimens in carrying two pairs of facets for the chevrons; they differ, however, by being thicker, nearly cylindrical, and by the greater length of the neural arch in proportion to the length of the centrum. The caudal vertebræ of *Cetiosaurus*, figured by Professor Philips in his Geology of Oxford, are very like those of *Pelorosaurus;* but the pre-zygapophyses are not cylindrical and do not project so far forward as in *Pelorosaurus*. The caudal vertebræ

* This specimen is called by Dr. Mantel "median caudal; it is, as stated in Philips' Geology of Oxford (p. 266) really a posterior caudal.

of *Hylæosaurus* also resemble our Indian specimens in having two pairs of facets for the chevron bones, and in having a longitudinal furrow on the neural aspect of the centrum; their articular surfaces are, however, nearly flat, and their centra sub-cylindrical.

The above comparisons, I think, prove quite clearly that our Jabalpur vertebræ belonged to a Dinosaur, closely allied to *Pelorosaurus* of the English Wealden, and to *Cetiosaurus* of the Bath oolite, and also presenting points of affinities to *Hylæosaurus* and *Iguanodon* of the Wealden. The Indian Dinosaur, however, differed from all the above genera in having the caudal vertebræ distinctly "procœlous" and laterally compressed.* From the large size of the vertebræ, I propose for the new genus the name of *Titanosaurus* with the specific name of Indicus. The length of the posterior caudal vertebræ of *Cetiosaurus* varies from five and a half to six and a half inches, so that our Indian species must have been nearly as large as the English giant. The forms of the articular surfaces of the vertebræ are quite sufficient to distinguish the Indian genus from all other genera of Dinosaurs.

Turning now to the femur, we find that this bone is embedded in matrix, and only shews its anterior aspect; both the condyles and the head have been broken away, so that we are unable to estimate either the full length or breadth of the complete bone; our specimen is from the left side, and agrees precisely in form with the larger femur of *Cetiosaurus* figured in diagram 108 of Professor Philips' Geology of Oxford; like that specimen, the anterior surface of our specimen is nearly flat, the inner border markedly concave, with a slight swelling two-thirds up from the distal end, which represents the third trochanter, and with the outer border less concave. The length of the fragment remaining is 46 inches, the breadth taken obliquely at the upper end 13 inches, the breadth of the narrowest part 8·3 inches, and of the broken distal end 11·5 inches. The specimen must have been at least 55 inches in length when perfect; the largest femur of *Cetiosaurus* known is 64 inches in length. The femur of *Pelorosaurus* is like that of *Cetiosaurus*, but smaller; that of *Iguanodon* is distinguished by possessing a third trochanter; the femur of *Hylæosaurus* is, I believe, not known. The size of the femur, therefore, shews an animal somewhat smaller than the largest individuals of *Cetiosaurus*, which Professor Philips estimates to have attained a length of sixty or seventy feet.

Both the vertebræ and the femur having been found in the same locality, and from the same formation—both belonging to Dinosaurian reptiles of gigantic size, and both having affinities to the same group of Dinosaurs—it is a logical inference that both should be referred to the same animal; if the femur had been found alone, I should have referred it to the genus *Cetiosaurus*, but the vertebræ forbid this view.

Both *Cetiosaurus* and *Pelorosaurus* were reptiles of terrestrial habits, probably living in marshy or estuarine districts, and we may infer that Titanosaurus, probably, had much the same habits; its occurrence in the Lametas indicates that these beds, as has previously been suggested, are of fresh-water orgin, like the Wealden of England. The caudal vertebræ of Titanosaurus belong to what we are usually accustomed to consider a higher type of structure than those of any of its European kindred. We may hope at some future date to find other remains of this huge Saurian, which will throw further light on its affinities, and shew whether it differed in other essential points from its European congeners.

The Lameta group of rocks are supposed by Mr. Blanford and Mr. Medlicott to be connected with the middle cretaceous rocks of Bagh (see Rec. Geol. Survey, India, vol. V, p. 115). The occurrence in these rocks of a Saurian closely allied to *Pelorosaurus*, and

* The caudal vertebræ of *Macrorosaurus semnus* from the Chloritic marl of Cambridge, are procœlous and compressed; this genus is doubtfully referred to the Dinosauria.

in some respects to *Hylæosaurus* and *Iguanodon* of the Wealden period, suggests that the Lametá group is not far removed from the lower cretaceous period—a view which would agree with their generally accepted position in the geological series.

I have lately found in the Indian Museum a considerable series of caudal vertebræ of this genus, which were collected by Mr. W. T. Blanford in the Lametas of Pisdúra; they are somewhat less compressed than the described specimen: and are accompanied by coprolites, and some portions of the carapace of a Chelonian. I shall hope subsequently to give figures of the more perfect specimens. The vertebræ and femur referred to by Mr. Hislop in the twentieth volume of the Journal of the Geological Society (p. 282) probably belong to this genus.

MEGALOSAURUS, sp.

the fourth volume of the "Memoirs of the Geological Survey of India" (p. 128), Mr. H. F. Blanford announced the occurrence of the remains of this genus in the Arrialur group of Trichinopoli (Upper Cretaceous); this announcement, however, does not seem to be generally known, as Professor Phillips in his "Geology of Oxford" (p. 196), in speaking of the distribution of *Megalosaurus*, makes no mention of its occurrence in India; for this reason I have introduced the genus here.

The specimen on which Mr. Blanford's determination was made is the greater portion of a (probably) lower tooth; this tooth is laterally compressed, the anterior border is convex and the posterior concave, both produced into trenchant edges and marked by fine serrations; the transverse section is somewhat pear-shaped, the broader portion being in front. The height of the portion of the tooth remaining is 1·8 inches; the antero-posterior diameter of the base ·91 inch, and the transverse diameter ·4 inch.

The tooth in form and size is almost identical with the teeth of *Megalosaurus Bucklandi* of the Stonesfield and Portland oolites, the only difference being that the posterior border of the Indian tooth is rather straighter than that of the English species.

In England the genus *Megalosaurus* ranges from the Lias to the Wealden, and is therefore chiefly characteristic of the Jurassic period. In India, as we said, it occurs in rocks, of which the marine mollusca fauna is homotaxically equivalent to that of the upper cretaceous rocks of Europe. This instance should make us extremely cautious in correlating the horizons of Indian and European rock-groups upon the sole evidence of land animals. As in many other instances in India, the land flora or fauna (exemplified in this case by *Megalosaurus*) of a group of rocks, indicates a lower homotaxis for the group than does the marine fauna. This anomaly is probably to be explained by the greater similarity of physical conditions, and the consequent greater facility for migration in the ocean than on the land (to say nothing of the insulation of parts of the latter), by which the organised products of the former would sooner arrive at a new station than those of the latter; the assumption in this case being that the wave of migration has travelled eastwards.

Further remains of the Indian form are required to establish its specific distinctness; the tooth will subsequently be figured.

PLESIOSAURUS INDICUS, n. sp. nobis.

I have already recorded* the occurrence of a species of the above genus from the Umia beds of Kach. On further examination, I now find that the specimen of the symphysis of a mandible, on the evidence of which the announcement was made, differs both in size and in the direction of the alveoli of the teeth from the mandible of *Plesiosaurus dilichodeirus* from the English Lias; it also differs, as far as I can make the com-

* Rec. Geol. Surv., India, Vol. IX, p. 154.

parison, from other described species of the genus; all the cretaceous and most of the oolitic species of English *Plesiosaurus*, however, are described from teeth or vertebræ only,* so that there is a possiblity of our species being identical with one or other of these forms. I have, however, thought it best to give the Indian form a distinct name, if only to mark the locality from which it was obtained, and I propose to call the species *P. indicus;* no more accurate definition, however, can be given than that published in the first notice. A species—*P. Australis*—has been described by Professor Owen from Australia, so that we now know that the genus had wide distribution in space as well as in time.

PACHYGONIA INCURVA.—*Huxley.*

This species of Labyrinthodont was described by Professor Huxley(†) from the Panchet group of rocks upon the evidence of a portion of a mandible wanting the extremity of the dentary piece; the jaw is characterized by carrying a row of minute teeth, which in cross section are transversely elongated. Among some specimens more recently acquired from the same group of rocks, I have found a part of a symphysial end of a left ramus of the mandible and a detached tooth of a Labyrinthodont, which belong to this genus. The mandible carries on its outer border a row of small, transversely, elongated teeth, from the form of which, and from the resemblance of the sculpture on the outer surface of the jaw to the same part in the type-specimen, I have referred the new specimen to *Pachygonia.* At the anterior extremity of the specimen, and placed somewhat internally to the outer row of teeth, there is one large conical tooth, longitudinally striated, and bearing the same relation and proportion to the outer row of teeth as does the similarly situated tooth in the jaw of *Labyrinthodon pachygnathus*, figured by Professor Owen in his Odontography (Pl. 63, fig. 5). A section of an isolated large tooth, which agrees precisely in form with the attached specimen, shews that the arrangement of the folds of the cement and dentine is almost precisely similar to those in the tooth of *Labyrinthodon* (*Mastodonsaurus*) *jaegeri*, as figured in Plate 64 A of Professor Owen's Odontography. I am not acquainted with the structure of the teeth of all other Labyrionthodonts, but those of two at least of the carboniferous genera (*Anthracosaurus* and *Archegosaurus*) differ very markedly from those of the Triassic type genus; in any case, the close resemblance in form of the symphysis of the jaw and of the structure of the tooth of *Pachygnathus* to the same parts in the jaw of the type genus *Labyrinthodon*, which is confined to the Keuper in Europe, affords a strong confirmation of Dr. Feistmantel's view, derived from the study of the flora, as to the homotaxis of the terrestrial forms of life of the Panchet group of rocks with those of the Keuper of Europe.

DICYNODON ORIENTALIS.—*Huxley.*

In a recent paper in the Quarterly Journal of the Geological Society of London (Vol. XXII, p. 98.), Professor Owen expressed his opinion that the foramen in the humerus of *Dicynodon orientalis*, from the Panchet rocks, is probably homologous with the foramen of *Cynodraco major* described in that paper. The Professor was, however, unable to be positive in this assertion, owing to the imperfect specimens figured by Professor Huxley in his above-quoted memoir on the Panchet vertebratæ. From an examination of more perfect specimens now in the Indian Museum, I am enabled to state that the foramen in the

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* British Cretaceous Reptiles, Owen,—Palæont. Soc. Phillips'Geology of Oxford.

† Palæontologia Indica, Ser. IV, Vol. I, p. 6.

humerus of *D. orientalis* is "entepicondylar," and consequently homologous with that of *Cynodraco* and not with that of the Lacertilia. On a future occasion I shall hope to give figures of these more perfect humeri, and also of other parts of the skeleton of *Dicynodon* and other vertebratæ from the Panchet rocks.

Myliobatis, Sp.

A specimen of a portion of the dental plates of a species of *Myliobatis* has been sent down by Mr. Wynne from the nummulitics of Kach; this is, I believe, the first recorded occurrence of the genus in Indian rocks. The specimen comprises the greater portion of four of the large median dental plates, and also shows on one side three small and diamond-shaped lateral plates; the small size of the innermost one of the three outer rows of dental plates, the two outer rows being absent, shows that the specimen belongs to the genus *Myliobatis*, and not to *Zygobatis*. The median teeth are rounded transversely, and somewhat hollowed near the middle line and along their outer border; their anterior border is concave. The antero-posterior diameter of these plates measures half an inch; the antero-posterior diameter of the external row of plates is also half an inch, and their transverse diameter three-tenths of an inch.

The plates are larger than those of any of the Bracklesham species of the genus, but most nearly resemble in form those of *M. Edwardsii*, from the middle eocene of that place. I think, however, that the Indian specimen will eventually turn out to belong to a distinct species.

The association of the remains of a species of *Myliobatis* with nummulites, and similar genera of Mollusca, in the eocenes of Bracklesham and Kach, is noteworthy, and serves to indicate that very similar conditions of climate must have prevailed in the two regions at the periods of the deposition of these strata. The genus is not known from strata older than the eocene, and is still represented at the present day.

Description of a new Emydine from the upper Tertiaries of the Northern Punjab, by W. Theobald, *Geological Survey of India.*

Throughout the vast series of beds superimposed on the nummulitic limestone in the Punjab, no remains are more common than fragments of different species of fresh-water turtle, belonging to the families *Emydinidæ* and *Trionychydæ*, though in too fragmentary a condition to be capable of more than generic recognition. During a late examination, however, of the upper Tertiaries south of Jhand, I have obtained two specimens, sufficiently preserved to afford a specific diagnosis. Both specimens consist of the anterior portion of the shell of a fully adult and aged animal, and embrace the three anterior, vertebral and costal plates, comparatively little affected by crust, and one specimen displays (though not very clearly) the ventral surface as far as the inguinal opening: the oval plates being broken away. Both specimens correspond as regards the structure of their plates, the impressed lines marking which are very distinct, though the same amount of individual variation is